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# Operational Assessment for Screener Proficiency Evaluation and Reporting System (SPEARS) Threat Image Projection

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16. Abstract

This document is the Operational Assessment (OA) of the threat image projection training and testing component of the Screener Proficiency Evaluation and Reporting System (SPEARS) conducted at Los Angeles International Airport in 1995.

This OA covers the test and evaluation of the EG&G Astrophysics Training and Testing (TnT™) system which focused on determining its effectiveness in meeting the requirements set forth in the Critical Operational Issues and Criteria, Critical Technical Issues and Criteria and Test and Evaluation Plan provided by the Federal Aviation Administration.

The TnT™ system did not meet 2 of the 3 Critical Operational Criteria and 4 of 7 Critical Technical Criteria during this test and should be considered ineffective and unsuitable in its current configuration.

17. Key Words

X-ray, X-ray screening, IED, Improvised Explosive Device, IED detection, IED detection training, signal detection, Screener Proficiency Evaluation and Reporting System (SPEARS), Human Factors Engineering, Fictional Image Projection, Threat Image Projection

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# PREFACE

This operational assessment was written to document the test and evaluation of the EG & G Training and Testing System at the Los Angeles International Airport (LAX) in 1995. It was tested according to the Critical Technical Issues and Criteria and Critical Operational Issues and Criteria set forth by the Federal Aviation Administration (FAA). These assessed the capability of the candidate Screener Proficiency Evaluation and Reporting System (SPEARS). The key FAA personnel who supported this testing effort are J. L. Fobes, Ph.D., Aviation Security Human Factors (AvSec HF) Program Manager and Engineering Research Psychologist for the Aviation Security Research and Development Division (AAR), D. Michael McAnulty, Ph.D., an Engineering Research Psychologist with the Center for Aviation Simulation and Human Factors.

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# LIST OF ABBREVIATIONS AND SYMBOLS

| | |
|---|---|
| $\beta$ | Beta, Operator Response Criterion |
| AAR-510 | Requirements Analysis and Integration Branch |
| ANOVA | Analysis of Variance |
| AvSec HF | Aviation Security Human Factors |
| $\underline{c}$ | Operator Response Criterion |
| CBD | Commerce Business Daily |
| CBT | Computer-Based Training |
| CO | Carry-On |
| COIC | Critical Operational Issues and Criteria |
| CTI | Combined Threat Image |
| CTIC | Critical Technical Issues and Criteria |
| $d'$ | d prime, Derived Operator Sensitivity |
| DCS | Digital Control Systems |
| DOT | Department of Transportation |
| FAA | Federal Aviation Administration |
| FTI | Fictional Threat Image |
| GSC | Galaxy Scientific Corporation |
| HF | Human Factors |
| HFE | Human Factors Engineering |
| IED | Improvised Explosive Device |
| LAX | Los Angeles International Airport |
| MBS | Modular Bomb Set |
| MOP | Measure of Performance |
| N | Noise |
| $N_{fa}$ | Number of False Alarms |
| $N_h$ | Number of Hits |
| OA | Operational Assessment |
| OT&E | Operational Test and Evaluation |
| $P_d$ | Probability of Detection |
| $P_{fa}$ | Probability of False Alarm |
| $P_h$ | Probability of Hits |
| ROC | Receiver Operating Characteristic |
| SDT | Signal Detection Theory |
| SN | Signal-Plus-Noise |
| SPEARS | Screener Proficiency Evaluation and Reporting System |
| T&E | Test and Evaluation |
| TEP | Test and Evaluation Plan |
| TIP | Threat-Image Projection |
| TnT™ | EG&G Astrophysics Linescan Training and Testing System |
| TVRTM | Test Verification Requirements Traceability Matrix |

# 1. INTRODUCTION.

## 1.1 PURPOSE.

This Operational Assessment (OA) documents the degree to which a candidate Screener Proficiency Evaluation and Reporting System (SPEARS) device, the EG&G Astrophysics Linescan Training and Testing System (TnT™), met the functional requirements established by the FAA as being necessary to produce an effective workforce of airport X-ray screeners. The SPEARS Operational Test and Evaluation (OT&E) was conducted to evaluate the ability of a candidate SPEARS to improve, maintain, and monitor airport X-ray screener performance through the use of Threat Image Projection (TIP) techniques. This OA addresses only the evaluation for the on-line testing and training component. The off-line instructional training portions of the SPEARS were investigated in an earlier T&E (see the Test and Evaluation Report [TER] for the SPEARS Computer-Based Training [Fobes, et al., 1995]).

## 1.2 SCOPE.

The SPEARS OT&E was designed to address the Critical Operational Issues and Criteria (COIC) and the Critical Technical Issues and Criteria (CTIC) as set forth in the SPEARS Test & Evaluation Plan (Fobes & McAnulty, 1995). SPEARS testing was conducted as part of the evaluation of the EG&G TnT™ on-line training and testing system. The COICs were evaluated during operational testing at the Los Angeles International Airport (LAX). Following operational testing, the CTICs were evaluated during technical testing in the FAA Aviation Security Laboratory and at the airport. The combined T&E focused on determining the degree to which the SPEARS device met the functional requirements embodied in both the COICs and CTICs, and in complying with Human Factors Engineering (HFE) design principles.

## 1.3 BACKGROUND.

### 1.3.1 SPEARS Program Background.

The SPEARS Program was initiated in response to a congressional mandate (Aviation Security Improvement Act of 1990, Public Law 101-604) tasking the FAA to improve aviation security through the optimization of Human Factors (HF) elements in the U.S. airport security system. The issue of screener performance and effectiveness was highlighted as an area requiring evaluation to identify potential security improvements. An aviation security Department of Transportation (DOT) task force supported this thrust by concluding that human performance was the critical element in the screening process.

The mandate directed that screeners be effectively trained to use threat detection equipment properly. The detection of explosive and incendiary devices was critically important because of the potential for significant damage, causing a crucial loss of life and aviation resources.

### 1.3.2 Functional Description.

The SPEARS consists of two components: (a) an off-line Computer-Based Training (CBT) system to teach screeners to detect various threat objects, and (b) an on-line threat image projection (TIP) training and testing component employed at airport security checkpoints. This latter configuration is to further develop and maintain threat detection proficiency by projecting simulated X-ray images of threat objects into X-ray images of actual passenger bags.

For the SPEARS to be effective, it must increase human ability in the identification of targets, namely threat objects. The aim of the SPEARS TIP component is to increase the vigilance (motivation) of screeners to detect threats within baggage through regular exposure to a variety of threat images. This exposure is accomplished by using TIP to insert Fictional Threat Images (FTI) onto the X-ray images of normal baggage flow being X-rayed, or to insert Combined Threat Images (CTI) consisting of fictitious images of passenger bags which also contain threat images into the normal passenger bag image flow. TIP exposure is expected to enhance detection performance in the following two ways.

a. Screeners will gain experience and thereby increase their ability to locate and identify a diverse array of threat objects under normal working conditions.

b. Regular exposure to threat images will increase screener attention levels, thereby maintaining the screener's ability to detect threats in cluttered bags.

Exposure to a large image library of threat objects should enhance screener familiarity with images of actual threat objects. Screener performance monitoring and feedback, accompanying false image insertion, should also provide increased motivation and vigilance. SPEARS provides training for many categories of threats. Historically, threat objects such as weapons have resulted in the highest detection rates in operational settings. In many cases, the detection rates associated with these types of threats would be difficult to improve. Comparatively, detection rates for Improvised Explosive Devices (IEDs) have been lower. IED detection performance was, therefore, of specific concern to this study.

### 1.3.3 Literature Review.

The expected performance effects from the SPEARS TIP component are supported by a review of the applicable HF and psychology literature, specifically in the areas of Signal Detection Theory (SDT), vigilance theory, and training.

1.3.3.1 Implications of Signal Detection Theory for the SPEARS.

SDT considers, in part, the role of human vigilance in human detection of infrequent target signals. A description of SDT is provided in Appendix A. Key to the purpose of the SPEARS TIP is the concept of vigilance decrement. The vigilance decrement has been defined as a decrease in human performance as a function of time on task (Wickens, 1992). In experimental paradigms, signal detection rates and signal detection measures (d′ [derived operator sensitivity] and β or c [Operator Response Criterion]) are collected in time increments, with the results demonstrating decreasing signal detection performance over time. Although many factors can contribute to this decrement, the factor most pertinent to X-ray screening of airline passenger baggage is criterion shifts associated with lower levels of target expectancy. Because the frequency of IED presentation for the screener in a real operational setting is extremely low, the screener may be unprepared to detect a threat object on the rare occasion when one is presented.

In SDT terms, the expectancy-derived vigilance decrement is attributed to an upward adjustment of the operator response criterion (or response threshold) in response to a reduction in the perceived frequency (and therefore expectancy) of target events (Wickens, 1992). If the operator response criterion is based on perceived target frequency levels, then additional missed targets may result in the perception of even lower target frequencies. The corresponding effect may be a continual decrease in detection performance.

Nadler, Mengert, and Carpenter-Smith (1994) indicate that inserting TIPs into the normal flow of baggage should increase the expectancy levels of the baggage screeners, thereby counteracting this adverse criterion shift and increasing overall detection rates of actual threat objects. To increase screener expectancy levels, adequate and immediate knowledge of results for both real and artificial threats is required. TIP must also increase operator sensitivity so that the shift in criterion is not accompanied by an increase in false alarms.

Operational screener watch durations are relatively short. For carry-on (CO) baggage screeners, the watch duration ranges from 20 to 30 minutes, depending on the security procedures in use at the particular airport. Similarly, the watch durations for checked baggage screeners rarely exceed 1 hour. The majority of vigilance decrement research has focused on tasks with watch durations of 1 hour or greater, usually focusing on conventional work shifts of 2-, 4-, or 8-hour watches. While it is doubtful that the degree of vigilance decrements detected towards the end of the eighth watch hour are directly applicable to a 20-minute or 1 hour session, vigilance decrement effects are expected to accumulate across multiple screening shifts.

The lack of actual threat presentation over several weeks, months, or years is expected to result in dramatically reduced signal expectancy. This effect might be counteracted through the systematic use of techniques (e.g., by regular insertion of FTIs and CTIs into the baggage screening environment) that change the expectancy of threat events. According to SDT, therefore, the SPEARS TIP may result in enhanced screener detection performance by maintaining appropriate response criteria over extended periods.

1.3.3.2 Implications of Training Theory on the SPEARS.

The training literature reveals implications for the design and implementation of a SPEARS device, although the training impact of TIP by itself should be limited. In a review of training literature, Goldstein (1986) found that distributed practice for procedural skills, such as X-ray screening, provides the most advantageous results over time. Massed practice sessions tend to show better immediate training results and also require less overall training time to achieve a minimum criteria. Massed, off-line, instructional training is, therefore, a necessary component of screener training. For retention over extended periods, however, the distributed or spaced training sessions will result in better overall performance. TIP, as a regular component of the screener's daily activities, should result in improved IED detection performance.

Practice alone will not provide adequate training retention in situations such as the present one, in which the trainee cannot determine response accuracy. Adequate retention requires a series of interacting training variables, which includes an adequate and timely knowledge of results and proper motivation of the trainees.

Another factor critical to the acquisition and subsequent retention of job skills is the extent to which training is transferred to the operational environment. The TIP concept employs the principle of *identical elements,* in that the training task uses the identical environment and stimuli to that of the actual screening task. Training theory predicts that this training principle should result in a high level of transfer of TIP training to the operational environment, which should result in increased IED detection performance.

## 1.4 SYSTEM DESCRIPTION.

For this SPEARS TIP OT&E, only one vendor, EG&G Astrophysics TnT™, agreed to have their TIP system evaluated.

### 1.4.1 EG&G Astrophysics TnT™.

The following is a technical description of the TnT™ components tested.

a. A color monitor and a black/white monitor mounted side-by-side, just as the monitors are mounted on the EG&G Astrophysics E-Scan X-ray machine.

b. A control panel mounted below the monitors that replicates the control panel on the E-Scan X-ray machine.

c. A trackball located to the right of the control panel that operators use to interact with the training programs.

d. A computer located inside the equipment housing that runs the training programs.

e. A variety of cables and connectors used to connect the training system to the EG&G Linescan X-ray and to the recording equipment, such as video recorders.

### 1.4.2 X-Ray Machine Modifications.

To allow for the connection of TnT™ workstations, input boards were installed by EG&G Astrophysics to two of the Linescan System Ten X-ray machines at LAX, Terminal 2.

## 2. TEST DESIGN AND CONDUCT.

### 2.1 EXPERIMENTAL DESIGN.

The experimental design for the operational test is an untreated control-group design with pretest and posttest measures (Cook and Campbell, 1979). This allowed for a direct assessment of the effects of the SPEARS TIP intervention on screener IED detection performance. The basic design was modified to include a second posttest data collection to measure the retention of the skill over time. Using Cook and Campbell's (1979) notation, the experimental design is depicted in Figure 1.

| | *time→* | | | | |
|---|---|---|---|---|---|
| Training Group | $O_1$ | $X_1$ | $O_2$ | $X_1$ | $O_3$ |
| Control Group | $O_1$ | | $O_2$ | | $O_3$ |

FIGURE 1. EXPERIMENTAL DESIGN

Where X indicates the SPEARS treatments (screener training on fictional images using the EG&G TnT™ system), and O indicates the ordinal number of screener performance tests where O1 is the pretest, O2 is the first posttest and O3 is the second posttest. The three tests had the same basic structure in that the screener viewed a computer-based series of 200 X-ray images of actual bags and had to decide which ones contain a simulated IED and which ones do not. Each test used the same bags but in random order. No screener took the same test order. The large number of bags and the planned 4 week time interval between the tests should minimize the chances of screeners memorizing the bags.

2.1.1 Independent Variables.

There were two independent variables other than screeners for the SPEARS TIP evaluation in the pretest and two posttests. The independent variable, SYSTEM, represents the SPEARS device and has two levels: training and control. The other independent variable, TRIAL represented the SPEARS training intervention and has three levels: pretest, first posttest, and second posttest.

For the TIP treatments themselves (training group only), time segments (by week) was the only independent variable other than screeners. The EG&G system cannot record false alarms by the screener and therefore SDT measures of operator sensitivity or response bias cannot be computed. The data will be divided into weekly segments for analysis.

2.1.2 Dependent Variables.

The dependent variables in the pretest and two posttests are derived from the off-line screener decision of IED presence for each bag and were the SDT variables of $P_{d\ (\text{probability of correct detection})}$, $P_{fa\ (\text{probability of false alarm or incorrect detection})}$, d′, and c. The only dependent variable in the analysis of TIP treatments was $P_{d\ (\text{probability of correct detection})}$. These SDT variables were not available for the TIP portion which is restricted to only $P_d$ for each screener by each weekly segment. The calculated values of $P_d$, $P_{fa}$, d′, and c were compared across training conditions.

For each screener, the bag decisions were converted to hits and false alarms based on the correctness of screener yes-no responses to whether an IED was present. $N_h$ and $N_{fa}$ are the total number of hits and false alarms across all bags.

For each screener, $N_h$ was used to calculate $P_d$ as follows:

$$P_d = N_h/N_T$$

where $N_T$ is the total number of test bag images presented.
$N_{fa}$ was used to calculate $P_{fa}$ as follows:

$$P_{fa} = N_{fa}/N_C$$

where $N_C$ is the total number of comparison bags presented.

After completing the IED test trials, the first step in the analysis was to separate the MBS bag responses from the comparison bag responses and to total these separately for each subject. The next step was to convert the raw data into a set of hit and false alarm rates. The values of $P_d$ and

$P_{fa}$ were then converted into $Z_h$ and $Z_{fa}$ by using the normal tables and plotting against one another

2.1.2.1 Predicted Results.

Two hypotheses were tested to determine whether the SPEARS is operationally effective for the development and maintenance of baggage screening skills.

Hypothesis 1 Training: Screener performance in detecting IEDs was significantly improved as a result of SPEARS TIP.

Hypothesis 2: Screener IED detection proficiency was maintained over time through the use of SPEARS TIP.

The first hypothesis requires an improvement in $P_d$ without a corresponding increase in $P_{fa}$ for the training group relative to the control group. The second hypothesis requires that this performance effect be sustained over time. If this improvement in performance does not occur or is not sustained over time, then the SPEARS is not operationally effective for either or both. Some research indicates that the performance should continue to gradually increase to some asymptotic level. For this study, however, the degree of this gradual increase is not predictable. A hypothetical representation of the hypothesized results is provided in Figure 2.

Similar hypotheses can be posited for the effects of SPEARS TIP on screener vigilance, but they can only be tested over time with the training group. Therefore, TIP performance will be divided into weekly segments and tested for the following hypotheses.

Hypotheses 3: Screener performance ($P_d$) was improved at detecting TIPs during the initial weeks of presentation.

Hypothesis 4. Once $P_d$ performance increased to asymptotic levels, it did not decrease during the later segments of the study (see also the trained performance line in Figure 2).

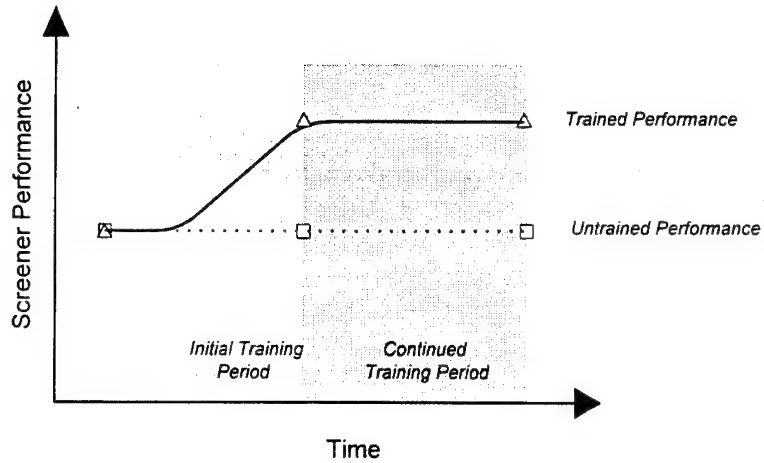



FIGURE 2. HYPOTHETICAL OPERATIONAL TESTING RESULTS

2.1.2.2 Statistical Analysis.

An effort was made to avoid contamination of the control group by selecting the training and control groups from two separate terminals at LAX. This control strategy does, however, impose some penalty on the statistical analysis of the resultant data. The primary penalty centers on the assumption of equivalent groups across the two treatment groups (Training and Control) within the SYSTEM variable. Statistical analysis procedures assume equivalent groups or a random assignment of individuals to groups. Without one of these control procedures, any effects discovered later in the study could be attributed to pre-existing differences in the group and not to the treatment.

Two approaches that control for these biases include experimental control and statistical control (Cook and Campbell, 1979; Kirk, 1982). In the present study, the primary experimental control was a pretest given to both groups to assess the magnitude of pre-existing performance differences between them. The pretest was very similar to the two posttests that are used to assess the treatments effects.

This experimental control method was employed and combined with a standard statistical analysis technique. A 2-Way Analysis of Variance (ANOVA) design was implemented (Kirk, 1982). The resulting experimental design allows for analysis of the main effect for SYSTEM, the main effect for TRIAL, and the interaction between SYSTEM and TRIAL using screeners' performance test scores as the dependent variable. Significant effects within SYSTEM, TRIAL, and the SYSTEM x TRIAL interaction can be investigated using post hoc Neuman-Keuls tests. Thus, even if the pre-test revealed some preexisting difference between groups, it would be possible to

meaningfully interpret the training as changing or having no effect on the groups' inherent performance differences.

Screener attrition resulted in unequal numbers in the training and control groups at the end of the study. An unequal-n ANOVA accordingly was conducted since the numbers were not overly disparate. There may be some unavoidable confounding effects due to repeated exposures of the participants to the data collection procedures used to determine performance. For example, screener performance may be improved over time simply because the screeners are more comfortable with the data collection trials, and not due to any training effect. However, this should affect both groups equally.

These controls were of less concern in analyzing the FTI performance, because all the data were collected on the same group. A one-way, repeated measures ANOVA was used to analyze the effects of exposure to FTIs on FTI detection.

## 2.2 USABILITY ASSESSMENT.

Descriptive statistics were used for the Likert Scale data collected on system usability. Any Likert rating having an average score of unacceptable is deemed to be a deficiency. Recommendations were made to rectify the deficiencies. Any software, hardware, or procedural aspects that were marked as failures on the HFE checklist, received negative comment by the screeners, or were noted during operation of the SPEARS equipment are reported and recommendations for improvement made.

## 2.3 OPERATIONAL TEST PROCEDURES.

### 2.3.1 Subjects.

Two groups of subjects, a training group and a control group, were used to conduct the operational assessment of the SPEARS on-line training and testing. The control group did not receive SPEARS TIP training during the OT&E. To the extent that the control group was aware of the activities of the training group, the members might have exhibited decreased performance over time caused by not being selected for special treatment. To reduce this effect, the training and control groups were physically separated by conducting testing at LAX in two separate terminals.

The initial sample consisted of 30 baggage screeners selected from the day (0630-1500 hours) and swing (1430-2300 hours) shifts at LAX Terminal 7 (United Airlines) and 24 screeners selected from the day and swing shifts at LAX Terminal 2 (Northwest Airlines). The number of

subjects for each group was chosen to account for anticipated attrition. (The attrition rates differed in the two terminals.) The Terminal 7 screeners participated in the control group and the Terminal 2 screeners participated in the training group.

#### 2.3.2 Subject Training.

The screeners were briefed about the study in terms of their activities, schedules, and expectations as participants. They also completed a consent form and a personal data form (see Appendices L and M) before participating in the study. The screeners received protocol instructions (see Appendix N) before the study and immediately before each major test activity.

Because training and experience varied across subjects, all participants attended a lecture session of X-ray screening philosophy and procedures, image interpretation, and possible threat objects. This training sought to equalize knowledge across subjects. The training required approximately 2 hours to complete.

Training on the use of the specific SPEARS device was provided to the entire Terminal 2 screening staff. Because of the flexibility inherent in airport baggage screener duty cycles, there was a chance that a Terminal 2 screener might inadvertently receive a TIP, even though the screener was not a member of the training group. To account for this eventuality, all Terminal 2 screeners received training to recognize and properly resolve a TIP.

#### 2.3.3 Pilot Study.

A pilot study was conducted approximately 2 weeks before the OT&E to verify the test protocol and data collection procedures. Data collection, the SPEARS TIP, and IED detection testing procedures were verified. Two screeners participated in the pilot study, one from each of the treatment groups.

#### 2.3.4 Operational Test Protocol.

The protocol describes the manner in which data were gathered to assess the operational effectiveness of SPEARS TIP. The specific protocol for each of these data collection exercises is described in sections 2.3.4.1 through 2.3.4.4.

Screening activities at LAX were carried out 24 hours per day, and were divided into three shifts. To obtain the required screener sample size, test events were carried out during the morning shift (0630-1500 hours) and the swing shift(1430-2300). The two shifts overlap for 30 minutes between 1430-1500 hours to ensure a smooth transition between shifts. During the transition, the

swing shift operates the screening stations and is monitored by the morning shift. Because data must be collected during two shifts, there were two equivalent data collection cycles during each day.

All briefing and data collection activities took place in Room 2034 and at the Security Checkpoint of Terminal 2 and in the Aloha Room of Terminal 7. Diagrams of the terminals and the rooms are provided in Appendix O.

2.3.4.1 Pretest.

The pretest was conducted to assess the baseline IED detection performance of the screeners participating in the study. Schedules for the pretest are included in Appendix P. Both the training and control groups were pretested concurrently. The geographic separation between the training and control groups required two sets of test administrators, one per group.

Data were collected on days one through three of the pretest and each screener was required once for a 2-hour period. Participants were also administered the Snellen equivalent High (96 percent) Contrast Vision Acuity Test (see Appendix Q for the score sheet).

Following selection as a study participant, each screener was assigned a subject number which was used to anonymously identify the screener during the study. Participants then received the computerized IED detection performance test. Before beginning the performance measurement, the data collector briefed each screener using the instructions contained in Appendices N, R, S, and T. Each screener was informed that simulated explosive devices would be present in some of the bag images to be screened during the test trial. Screeners carried out normal screening operations and did not receive operational direction from the test administrators.

This test required approximately 35 minutes. Before each test session, the FAA data collector assigned an operator identification number to each screener for access to the test device and ensured that the test device was operable and properly configured. If the test device malfunctioned during the test trial, the data collector informed the test manager, who arranged for maintenance.

The data collector started the test trial and asked the screener to begin the test. The testing device automatically displayed the first bag image to the screener. The screener's task was to indicate whether the bag contained a threat image, within 10 seconds, by pressing the appropriate key on the keyboard. After the screeners had responded to this initial question, they were asked a second question based upon their response to the first question. They were asked to indicate how confident they were in their original response concerning the presence or absence of an IED in the bag. The testing device recorded the response and automatically forwarded to the next image. The data collector stopped the test when all bag images had been presented.

Each computerized test consisted of 25 test bag images containing Modular Bomb Sets (MBS) within a series of 175 CO comparison bag images for a total of 200 bag images. A description of the test bag configuration is included in Appendices U and V. All screeners in the study viewed the same test and comparison bag images. To control for presentation order, six randomly generated presentation orders for the 200 bag images were used.

The control group returned to normal duties after the IED test. Instruction in the operation of the SPEARS TIP training equipment and the procedure for threat resolution when the TnT™ TIP feature becomes operational was provided to the Terminal 2 staff. The participants were then returned to their normal duties.

2.3.4.2 On-line TIP Testing.

The basic task of the X-ray screener is to monitor X-ray images presented on display screens and identify potential threat objects within the images. The task for both SPEARS TIP and IED detection testing matched this basic operational task: Screeners examined bags and were to identify those that contained a potential threat object.

The SPEARS TIP task involved the X-ray screeners carrying out normal screening duties at their usual screening station (Terminal 2 checkpoint). TnT™ devices were connected to two of the three X-ray machines at the Terminal 2 checkpoint, as depicted in Appendix O. The TnT™ devices were configured to have the TIP function insert up to 24 FTIs into the normal passenger baggage flow to be observed by each screener on a given day.

The method for FTI selection and insertion was as follows. The number of FTIs presented to each screener on a given day is detailed in the randomly generated protocol shown in Appendix W. During each 8-hour shift, the duty cycle for a screener normally consisted of a 20-minute period on the X-ray equipment, 20 minutes using the wand for body searches, 20 minutes performing bag searches, and 20 minutes off. A normal shift also included a 30-minute lunch break. This duty cycle results in each screener being on the X-ray equipment a maximum of once per hour, and a total of approximately four sessions per shift. Because of the inherent flexibility of screening operations, it is impossible to determine when these four sessions will occur for each screener. For this reason, each hour of each shift was divided into three, 20-minute segments. The number of FTIs presented to a screener on a given day was doubled and spread across the eight-hour shift. The number of FTIs presented in each hour was replicated in each 20-minute segment. Using this procedure, reasonable assurance was provided that each screener would be able to receive close to the required number of FTIs and that all screeners could receive approximately the same FTI exposure on a given day. The flight schedule for Terminal 2 is included in Appendix X. The ebb and flow of passengers resulted in uneven FTI presentation rates across screeners. This is unavoidable given the operational environment and the way the device can be programmed.

When the X-ray screener believed a threat object was present in a bag, the screener pressed the TnT™ TIP button to elicit a response from the SPEARS device. If the bag contained an FTI, the SPEARS device confirmed the fictional threat object and indicated it on the display. The threat object was then erased from the screen, allowing the X-ray screener to ensure that there were no real threat objects in the bag. Only one FTI per bag was generated by the SPEARS device, but there was a possibility of an actual object in the bag. If the bag did not contain an FTI, but the screener indicated a possible threat through the TIP key, notification of no projection was given to the screener, and normal security procedures were followed (see Appendix T. If the screener failed to detect the FTI, the TnT™ notified the screener of the miss and recorded the presentation in the screener's database.

2.3.4.3 First Posttest.

The first posttest was conducted 6 weeks after the pretest and consisted of IED detection testing only. The control group had 24 screeners remaining (out of 30) and the training group had 23 screeners (out of 24). This testing followed the same protocol contained in the pretest description. Each screener was required to take a test session lasting approximately 35 minutes. The first posttest required 2 days to complete. The control group and training group were tested concurrently.

2.3.4.4 Second Posttest.

The second posttest was conducted 8 weeks after the first posttest and again involved a 35-minute IED detection test session for each screener. The control group had 20 screeners remaining (of 30) and the training group had 17 screeners remaining (of 24). The second posttest had to be delayed by several weeks due to heightened security alerts during this time period at LAX. Following IED detection testing, each screener in the training group completed a usability assessment form. The second posttest required 3 days to complete. The training group and control group were tested concurrently.

2.3.5 SPEARS Usability Assessment Methodology.

The tailored Usability checklist was completed during the testing of the technical issues. The subjective ratings covered the SPEARS operating procedures and feedback provided by the SPEARS device during real time baggage screening. The ratings were provided through 5-point Likert scales (see Appendix C) developed for the SPEARS training and testing and administered to each screener in the training group during the second posttest session. The structured assessment(see Appendix B) was conducted to probe the usability of the SPEARS device and are complementary to the Likert scale ratings.

### 2.3.6 Technical Test Procedures.

Technical test procedures are described in the Test Strategy Results for each Technical Issue. Most technical test data were collected by Human Factors Engineers using observation and tryouts based on checklists appropriate for each domain. The checklists are presented in Appendices D through K.

## 2.4 TEST LIMITATIONS AND IMPACT.

A number of known or unforeseen constraints and events during the conduct of this test may have had some influence on the results or their interpretability.

Screeners reported difficulty using the trackball. In a few instances, this may have affected responding in a timely manner to the images.

Screeners often used other operators' IDs to login, possibly to prevent their results from being identified. In about 5% - 10% of these cases, it was not possible to reconstruct which individual had taken a particular session. This had an approximately random pattern of occurrence.

It was not possible to ensure that all screeners in the training group got a uniform amount of exposure to the TIP treatment. Some subjects had no TIP practice for several weeks. Others had consistent but extremely limited amounts of exposure to the items, e.g 2-4 items for several weeks in a row. Thus, it is not clear what training benefit might be expected for those screeners who received limited or intermittent TIP exposure.

As noted, the training aspects of detecting the FTIs were examined using a computer-based device to present the black and white X-ray image. The primary reason for using the computerized device rather than actual baggage containing MBSs was to avoid the negative effects that multiple trials using actual bags would have had on passenger flow and airline operations. The computerized presentation of images lacks some aspects of operational representativeness but, on the other hand, improved the probability of retaining the screener's full attention to the task. The screeners analyzed actual X-ray images and had to respond quickly to each image, simulating the passenger flow requirements at the checkpoint.

The SPEARS TIP is meant to be tailored by supervisors to individual screener abilities, training needs, and workload. Such tailored training and testing could not be done during this OT&E, and a more generic training and testing protocol was used (see section 2.4.2.1). Therefore, the SPEARS TIP training could not be implemented in optimal fashion for all of the screeners in this study.

## 3. RESULTS AND ANALYSIS: OPERATIONAL AND TECHNICAL TEST.

This section presents the data and associated analysis for each Critical Operational Issue and Critical Technical Issue as defined by its Criteria, Measures of Performance (MOPs), and test strategy.

The issues were investigated through screener performance data collected during the study, and through subjective comments and ratings collected after the study's completion. Additional data for the usability issue were collected by using a tailored Usability HFE Checklist (Appendix B) based on the *Guidelines for the Design of User Interface Software* (Smith and Mosier, 1986).

SPEARS TIP Training and Testing Data.

For each of the pretest and the two posttests, the screener decision and confidence responses observed while scanning for simulated IEDs in the computerized passenger bag X-ray images were collected for each screener in both groups. During the TIP training periods, data were collected on the number of TIP hits and misses for each screener.

SPEARS Usability Data.

The data resulting from the SPEARS usability analysis were the HFE checklist data, the Likert scale responses, and any procedural errors noted when the training group subjects operated the SPEARS device.

### 3.1 OPERATIONAL CRITERIA AND RESULTS.

#### 3.1.1 Operational Issue 1: Training Effectiveness.

Does TIP enhance screener performance?

Criterion A. Projecting fictional images is accompanied by a sustained increase (statistical) in the screener's probability of detection ($P_d$) of IEDs.
Criterion B. Projecting fictional images is not accompanied by a sustained increase (statistical) in the screener's probability of false alarm ($P_{fa}$) when scanning for IEDs.
Criterion C. Projecting fictional images is accompanied by a sustained increase (statistical) in the screener's d′.

3.1.1.1 Test Strategy.

MOP data were collected concurrently for two groups of screeners during the operational testing at LAX. One group of screeners, the experimental group, was exposed to the SPEARS TIP. The other, the control group, was tested without exposure to the SPEARS TIP. To determine the effect of SPEARS training on IED detection performance, $N_h$ and $N_{fa}$ was recorded for individual screeners three times during the study: (a) during a pretest before the SPEARS TIP training begins for the experimental group, (b) during a posttest 6 weeks after the pretest, and (c) during a second posttest 8 weeks after the first posttest.

The MOP data were used to derive $P_d$ and $P_{fa}$ for each screener. The values of $P_d$ and $P_{fa}$ were then compared between training and control conditions and across measurement periods to determine the effect of the SPEARS TIP on IED detection performance.

3.1.1.2 MOPS and Data Presentation.

MOP 1. The Number of Hits ($N_h$) for test bag images collected before and after exposure to the SPEARS treatment.

NOTE: The number of hits for training and control group subjects is included as part of the analysis of d' in MOP 3 of this section.

MOP 2. The Number of False Alarms ($N_{fa}$) for comparison bag images collected before and after exposure to the SPEARS treatment.

NOTE: The number of false alarms for training and control group subjects is included as part of the analysis of d' in MOP 3 of this section.

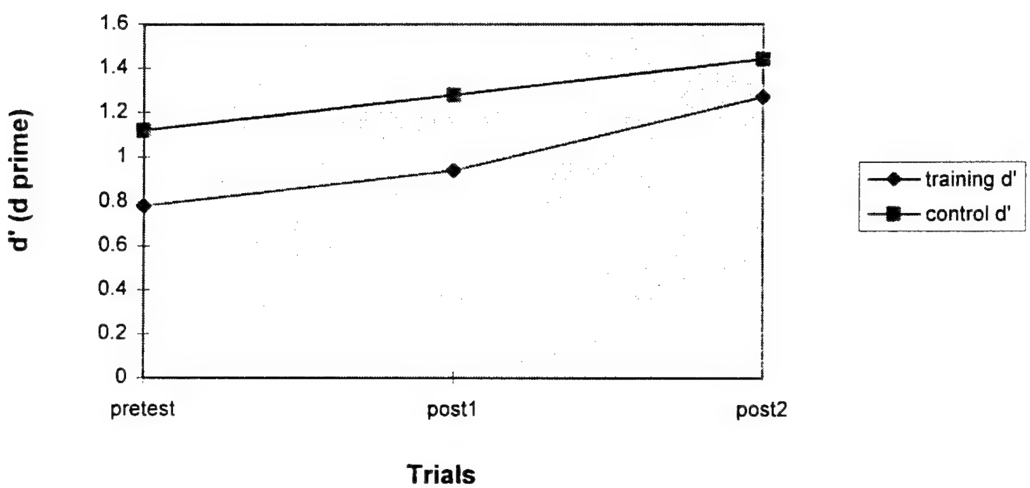
MOP 3. The d' to detect the test bag images collected before and after exposure to the SPEARS treatment.

The operator sensitivity measure (d') means are displayed in Figure 3 for the training and control groups for the pretest, posttest 1 and posttest 2. Test completion times and the signal detection performance of the two groups were compared across test trials. Five two-way ANOVAs with one repeated measure were conducted with group (training, control) and trial (pretest, posttest 1, posttest 2) as the independent variables. Trial was also a repeated measure since the same subjects took all three tests. The dependent variables were test time, Pd, Pfa, d' or $\beta$.

The ANOVAs revealed significant differences between groups on screener sensitivity but not in the expected direction nor differentially across trials. That is, the control group had higher mean screener sensitivity (d') on the pretest and both posttests than did the training group ($F_{2, 70} = 9.44$, $p < .01$). However, there was no significant interaction between trial and group. That is, the difference between groups remained stable across trials. Both groups also had statistically equivalent test completion times. There were no significant differences between groups or across trials with Pd, Pfa, or β.

Mean screener sensitivity, d', increased significantly across trials for both groups ($F_{1, 35} = 4.21$, $p < .05$). The training group had a significant increase in sensitivity going from a mean sensitivity of .79 at the pretest to 1.28 at posttest 2 (Duncan post-hoc, $p < .05$). The control group had a significant increase from 1.14 in the pretest in 1.44 in the first and second posttests respectively. (Duncan post hoc, $p < .05$)

**Fig. 3 MEAN OPERATOR SENSITIVITY ACROSS TRIALS**




3.1.1.3 Analysis and Discussion.

The ANOVAs indicate that the screener performance was little influenced, if at all, by the TIP training. The higher sensitivity of the control group on the pretest compared with the training group was unexpected, but in no way compromises the analysis. The TIP treatments simply need to increase training group posttests performance at a faster rate than occurs from the control

group in order to demonstrate their effectiveness. However, a significant increase in sensitivity was found in both the training group and the control group across trials. Since there was no significant increase in hit rate or false alarm rate, it is unclear how much weight to accord this isolated result.

An examination of the performance on individual test items (on the pretest) did not reveal any items which were either overly easy or overly hard, which might have skewed the results. Only two items were gotten right by more than 85% of the 54 pretest takers. No item was missed by everyone.

The reason that mean screener sensitivity increased for both groups cannot be determined on the basis of the data. However, typical causes for such general non-treatment based increases in performance include greater familiarity with testing procedures or the kinds of items presented, less stress on the second and third sessions and attrition of poorer performers. Perhaps most importantly, security levels were raised at the airport after the test had begun. One or more of these factors probably account for the observed findings.

### 3.1.2 Operational Issue 2: Vigilance.

Does SPEARS TIP increase and sustain screener vigilance in detecting threat images?

Criterion A. There is a sustained increase (statistical) in $P_d$ of FTIs for the TIP training group during the first 4 weeks of the study.
Criterion B. There is a sustained increase (statistical) in $P_d$ of FTIs for the TIP training group during the last 8 weeks of the study.

#### 3.1.2.1 Test Strategy.

MOP data were collected during OT at LAX. The SPEARS device was installed at the airport and used by the experimental group of screeners over an extended period. To determine the effect of SPEARS TIP on screener vigilance, the number of FTI presentations and $N_h$ were observed and recorded for the experimental group screeners throughout the SPEARS intervention. Unfortunately, the SPEARS device does not record false alarms or the total number of passenger bags screened, so other measures (e.g., SDT measures) cannot be computed. The resulting Pd measures were compared across weekly segments of the study to determine if screener performance increases from initial levels and is then maintained over time.

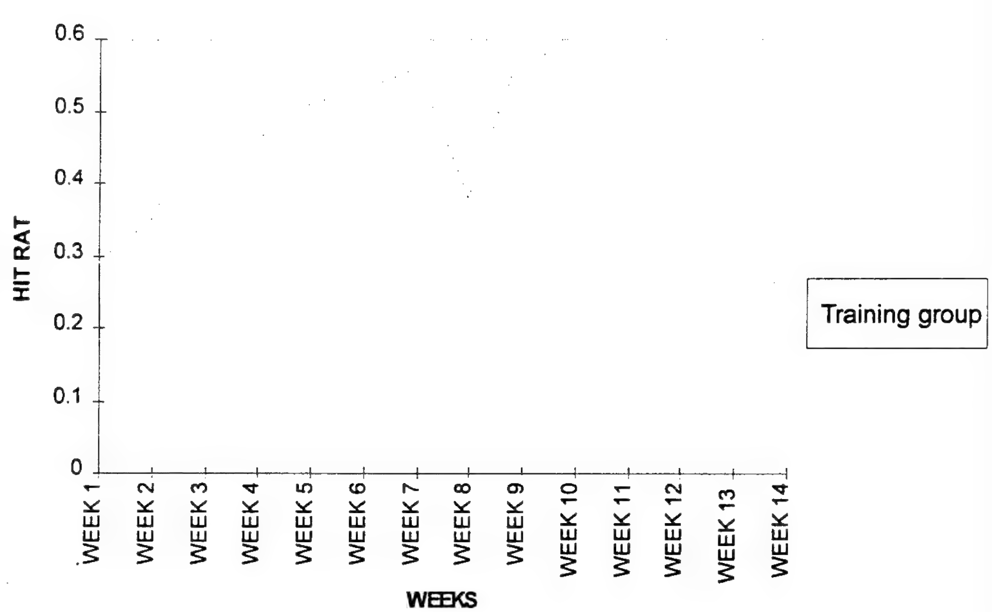
#### 3.1.2.2 MOPS and Data Presentation.

MOP 5. The $N_h$ for FTIs collected across the first 6 weeks of the FTI treatment.

NOTE: Due to the delay in testing caused by enhanced security operations at LAX, the first part of the test was extended by 2 weeks beyond the original schedule of 4 weeks.

The mean hit rate across weeks of TIP presentation are shown in Figure 4. There was a large jump in hit rate between weeks 2 and 3 when the performance went from .36 to .51 hit rate. After this one time jump, the training groups' performance remained quite consistently at this level.. A series of within-subjects ANOVAs of FTI Pd by week was performed. Consistent with the differences noted above, a significant effect was observed for the weeks before the first posttest (F=3.55, p<.01)

**Fig. 4 MEAN HIT RATE ACROSS TIP TRAINING**




<u>MOP 6</u>. The $N_h$ for FTIs collected across the last 8 weeks of the FTI treatment.

The hit rate remained at the levels seen after week 2 in the first part of the test. There was a jiggle in weeks 8 and 9 as hit rate went down and then back up to the levels seen in the first half of the test. This was the basis for the significant effect on screener Pd for the weeks between the first and second posttests (F=2.92, p. <.05). Only one screener out of 18 showed a significant increase in performance over the 14 week period however, (Duncan post-hoc, p. < .05). No significant effects were found between screener FTI Pd between the first and second posttests.

### 3.1.2.3 Analysis and Discussion.

A treatment effect on vigilance would have some of the characteristics that are seen in the data here. That is, if TIP presentations led to an increase in attending to and analyzing X-ray images, then we should see a relatively rapid rise in performance that is sustained over the period of the treatment. However, an increase in vigilance can occur for a variety of reasons and not just as the result of TIP. During the time period in question, LAX had several increases in security level due to concerns about the Trade Center trial and threats made by the UnaBomber. This may well have heightened the screeners' focus on detecting threats in baggage. The significant increase in control group sensitivity supports this interpretation.

As noted in the section on Test Limitations, the TIP treatment could not be operationally administered in uniform fashion to all members of the training group. This was due to a serious system design limitation which precluded the linkage of TIP presentations with individual ID numbers. Since the screeners do not follow strict schedules at each station, there was no way to know when an individual was going to be engaged in X-ray screening. Thus, the amount of training and vigilance benefit was compromised to some extent. The variability of TIP exposure was quite large. One screener received 130 TIP exposures over 14 weeks. At the other end, one screener had 26 exposures over the 14 week period and had no exposure on 5 of those weeks. The analysis of individual screener trend data over trials revealed only one screener in the training group whose performance increased significantly over the course of the TIP treatments themselves (the subject received 79 TIP exposures, incidentally).

The essential problem with the TIP as presented by the system is that the lack of appropriate feedback and inconsistency of presentation schedule. These make it highly unlikely that screeners can improve their skill at detecting threats. If screeners don't already have all the necessary training and demonstrated ability to detect these threat images prior to TIP then they will not acquire them from TIP which lacks such capabilities. Thus, it is probable that the false alarm rate went up as well when the hit rate went up, although this could not be determined due to limitations of the report capabilities of the TnT™.

### 3.1.3 Operational Issue 3:Usability.

Are there any software or hardware factors or procedural aspects that degrade the screeners' or supervisors' ability to use the system effectively?

Criterion A. Investigative in nature.

3.1.3.1 Test Strategy.

The usability issue is relevant to the supervisors who program the machine and to the screeners who must detect and respond to the TIP capability (i.e., TIP button on the TnT™). The usability evaluations consisted of completion of rating scales by the participating screeners and supervisors (Appendix C). Data also included the application of a tailored SPEARS Usability Human Factors Engineering (HFE) checklist (see Appendix B) based on the *Guidelines for the Design of User Interface Software* (Smith and Mosier, 1986) and MIL-STD-1472D.

3.1.3.2 MOPS and Data Presentation.

MOP 7. Subjective ratings of system usability by screeners and supervisors.

The mean screener responses items in the Usability Survey are presented in Table 1, (See Appendix C SPEARS OT&E Screener Usability Ratings, for questions). All but two mean item responses had a narrow range from 3.35 to 3.93 (5 point scale: 1 - minimum, 5 - maximum) indicating neutral or slightly positive opinions concerning the utility and ease of use of the TIP training and testing. The two highest rated items were items 5 (4.65) and 6 (4.12) which dealt with using the TIP function and operating the TIP key on the computer. Screeners felt moderately positive concerning the key desired characteristics of the TnT™ system, namely, its efficacy in improving the ability to detect explosives and its desirability as an on the job training tool.

TABLE 1. MEAN SCREENER USABILITY RATINGS

| Question | Valid N | Mean | Std. Dev. |
|---|---|---|---|
| | | | |
| 01 | 17 | 3.82 | 1.19 |
| 02 | 17 | 3.76 | 1.35 |
| 03 | 17 | 3.59 | 1.66 |
| 04 | 17 | 3.24 | 1.72 |
| 05 | 17 | 4.65 | 0.70 |
| 06 | 17 | 4.12 | 1.22 |
| 07 | 16 | 3.75 | 1.61 |
| 08 | 17 | 3.88 | 1.17 |
| 09 | 15 | 3.60 | 1.40 |
| 10 | 16 | 3.75 | 1.48 |
| 11 | 17 | 3.65 | 1.50 |
| 12 | 17 | 3.35 | 1.41 |

| | | | |
|---|---|---|---|
| 13<br>14<br>15 | 17<br>17<br>17 | 3.35<br>3.93<br>3.82 | 1.73<br>1.49<br>1.59 |
| | | | |

MOP 8. HFE Checklist results.

The TnT™ has mostly acceptable usability properties, although some significant deficiencies were noted which should be corrected. The most troublesome deficiencies lay in the domain of user guidance. The system did not display error messages or offer other guidance to the operator concerning invalid entries. It also provided no status information about on-going operations, system delays or other activities, e. g., no confirmation of ID number. The Help feature was not working either. A variety of other user interface deficiencies were noted. The screen had low contrast and was difficult to read in the relatively dim airport environment. No highlighting or other forms of enhancement were used to make important or changing information stand out. Coloration in graphs was arbitrary and meaningless. There was no Undo command to correct an immediately preceding error. Users could not reverse their path on some menus to return to the preceding (higher ) menu. In addition, cut/paste editing functions were not available.

### 3.1.3.3 Analysis and Discussion.

This issue is judged Partially Met, since some interface deficiencies exist which absolutely require correction. It also should be noted that screeners had only mildly positive opinions about the system's effectiveness in promoting skills in detecting IEDs. The lack of feedback on responses and absence of status messages is the most serious interface deficiency. This may have contributed to operators' lukewarm opinion of its utility since they could not really learn what characteristics of threats were causing them the most problem and try to learn how to better recognize them. If the TIP is to be used purely as a motivator, then screeners must be fully trained on the detection of threats prior to exposure to TIP.

## 3.2 TECHNICAL CRITERIA AND RESULTS.

This section identifies each Critical Technical Issue, its related criteria, MOPs, and test strategy to be addressed by OT&E. Several of the technical issues for this OT&E are redundant with technical issues tested in the SPEARS CBT T&E. All technical issues are restated here for clarity.

Unless otherwise stated, the MOPs were collected through structured protocols conducted in either the Aviation Security Laboratory or on-site at the airport. The data resulting from the technical MOPs include the answers to the structured interview question concerning summary report understandability, annotated results from the review of pertinent aspects of the SPEARS device against HFE checklists, assessments of FTI and CTI insertion order and FTI position assignment within bag images, image control, and researcher observations.

MOP data for each technical issue were assessed against its related criteria to ensure compliance with system technical requirements. The individual SPEARS technical issues checklists will be evaluated to ascertain the extent that these criteria have been met. Responses from the structured interviews augmented the IED test, TIP performance, and technical issue checklist data.

### 3.2.1 Technical Issue 1: Image Content.

Do images represent the range of current threats?

Criterion A. At least 300 different CTIs will be available representing threat categories of weapons, incendiaries, explosives, and other dangerous/deadly devices.
Criterion B. At least 300 different FTIs will be available representing threat categories of weapons, incendiaries, explosives, and other dangerous/deadly devices.
Criterion C. At least two different aspect angles will be available for each particular threat object.
Criterion D. The degree of detection difficulty varies.

#### 3.2.1.1 Test Strategy.

An inspection of the threat object database was made to determine whether at least 300 different CTIs and 300 FTIs are available, and that these were representative of the threat categories of weapons, incendiaries, explosives, and other dangerous/deadly devices. The inspection also determined whether at least two different aspect angles are available for each CTI and FTI and that the degree of detection difficulty varied for these different items in CTI displays ( cf. the SPEARS Image Content Checklist in Appendix D).

#### 3.2.1.2 MOPS and Data Presentation.

MOP 9. The number of CTIs available.

The TnT™ does not provide CTIs.

MOP 10. The threat category of each CTI available.

Not demonstrated. See MOP 9.

MOP 11. The number of FTIs available.

There are a total of 216 FTIs available.

MOP 12. The threat category of each FTI available.

Table 2 presents the number of FTIs for each threat category.

TABLE 2 NUMBER OF FTIS FOR EACH THREAT CATEGORY

| FTI Threat Category | # of FTIs |
|---|---|
| Weapons | 96 |
| Explosives | 65 |
| Explosives Components | 55 |

MOP 13. The aspect angles available for each CTI.

Not demonstrated. See MOP 9.

MOP 14. The aspect angles available for each FTI.

At least two different aspect angles were available for each FTI presentation.

MOP 15. Detection difficulty of the FTIs varies as a function of the contents of the actual bag being examined and will, therefore, not be assessed. CTIs were assessed by ratings provided by screeners or subject-matter experts.

Not demonstrated. See MOP 9.

3.2.1.3 Analysis and Discussion.

This issue is judged not met. Since the TnT™ could not display CTIs, all MOPs involving CTIs could not be evaluated. The system did present FTIs in the specified categories and aspect angles; however, only 216 of the 300 required FTIs were available.

3.2.2 Technical Issue 2: Customization.

Can performance monitoring be tailored to individual screener needs?

Criterion A. Images can be selected for each screener as a function of threat category, difficulty, and aspect angle, which are archived along with the associated outcome of the FTI (hit, miss, false alarm, correct rejection).

Criterion B. FTIs and CTIs can be automatically or manually selected for presentation based on such factors as time of day, checkpoint activity, or screener identity.

3.2.2.1 Test Strategy.

During the OT&E, the SPEARS Customization Checklist (Appendix E) was used to assess the degree to which TnT™ performance monitoring has been tailored to individual screener needs. The checklist items covered the methods for selecting and archiving of CTIs and FTIs using both manual and automatic processes.

3.2.2.2 MOPS and Data Presentation.

MOP 16. The methods of selecting CTIs based on image factors.

Not demonstrated. See MOP 9.

MOP 17. The methods of archiving results for CTIs based on image factors.

Not demonstrated. See MOP 9.

MOP 18. The methods of selecting FTIs based on image factors.

FTIs cannot be customized as a function of threat category, level of difficulty, aspect angle, or as a combination of these functions.

MOP 19. The methods of archiving results for FTIs based on image factors.

FTIs can be archived with the associated screener response outcome (hit, miss) and including the date and time of day.

MOP 20. The methods of selecting CTIs based on external factors.

Not demonstrated. See MOP 9.

MOP 21. The methods of selecting FTIs based on external factors.

Although FTIs can be selected automatically based on time of day, they cannot be selected based on checkpoint activity, screener identity, or as a combination of these functions. The TnT™ records screener FTI detection performance and maintains this information in performance reports. Reports are date and time stamped.

3.2.2.3 Analysis and Discussion.

This issue was judged not met. Again, the MOPs related to CTIs could not be evaluated. As for FTIs, the system did not permit customization of the image selection process except using time of day. Customization of the archiving process of performance reports for FTIs was limited to external factors such as time of day.

3.2.3 Technical Issue 3: Feedback.

Is feedback provided?

Criterion A. The device will immediately inform the screener on whether each threat object was correctly identified.

3.2.3.1 Test Strategy.

Test bags not containing actual threat objects were passed through the X-ray scanning device. The SPEARS device was used to insert threat object images onto the test bag images. In addition, test bags were run through without receiving FTI projections. The researcher would correctly or incorrectly press the TIP key when an image is presented and record the feedback provided. For the purposes of this test, feedback is defined as any combination of visual or auditory messages that is intended to alert the X-ray screener and explain the status of the image scanning. Additionally, the checklist (Appendix F) was used to determine the extent to which screener feedback is provided.

3.2.3.2 MOPS and Data Presentation.

MOP 22. The feedback provided by the SPEARS device regarding the accuracy of threat object disposition as determined by demonstration and inspection.

The TnT™ provides feedback to the screener for the FTI when connected to the Linescan X-ray equipment. Operator feedback is displayed in a consistent position and also has a consistent format and content. Feedback is provided for correct FTI identification and for threat images, however, the feedback is slow to be displayed. Missed threats are not identified and the FTI is displayed for an insufficient time before it is removed.

3.2.3.3 Analysis and Discussion.

This issue was judged not met. Although feedback is provided on operator correct responses, the system is slow to display it. More importantly, the system does not provide feedback on missed threats, which is critical to effective training of screeners to detect targets. If they are not shown which targets were missed, they can never achieve the additional skill level required to detect more difficult threat images. The lack of feedback would be less critical if screeners were at a high state of proficiency prior to TIP exposure.

3.2.4 Technical Issue 4: Capability Summaries.

Are performance reports prepared?

Criterion A. The device automatically generates performance reports containing descriptive statistics and readily understandable interpretations to summarize records of threats presented and the outcomes

Criterion B. Supervisors can be alerted when screener performance falls below operational requirements during a screening session.

3.2.4.1 Test Strategy.

The performance reports were automatically tabulated and produced by the SPEARS device upon prompting by the researcher. A SPEARS Capabilities Summaries Checklist (Appendix G) was also used to evaluate the content and presentation methods employed in the performance summary reports.

3.2.4.2 MOPS and Data Presentation.

MOP 23. The content and presentation method of summary reports provided by the SPEARS device as determined by demonstration and inspection.

The TnT™ reports contain screener performance scores and descriptive statistics. They can be presented on the TnT™ monitor and printed. The Users Log Report shows a date and time stamp for operator log-on. Some operational problems were noted, however, in generating reports since some of them take up to 30 minutes to generate and display or print out. During this time, the computer is locked to the operator, who cannot perform another activities with the system.

MOP 24. The degree to which reports are determined to be understandable through interviews with screeners and supervisors and assessment using HF checklist design principles and criteria.

The TnT™ manuals provide explanations and examples of the various reports which also explain when and how to use them. The headings on the Users Log Report are easily understandable except for the third column which is labeled only with a "C". Labeling the column as "Class" would be more intelligible.

MOP 25. The performance tracking of each screener's missed threat totals and their transmission to supervisors by the SPEARS device as determined by description and inspection.

Not demonstrated. See paragraph 3.2.5 Interoperability

3.2.4.3 Analysis and Discussion.

This issue was judged not met. The system did not automatically warn supervisor of inferior performance. Although some reports do take an excessive amount of time to generate, few other problems were noted or observed.

3.2.5 Technical Issue 5: Interoperability.

Can the TnT™ equipment communicate with remote computers?

Criterion A. Additional FTIs and CTIs can be received from remote sites.

Criterion B. The equipment will be able to transmit reports to remote sites.

3.2.5.1 Test Strategy.

The Interoperability Checklist (Appendix H) was used to evaluate the extent to which the TnT™ equipment can communicate with remote computers. A computer was installed at a remote location and connected by modem with the device at the test site. A researcher at each location attempted to download new images to the SPEARS devices. Additionally, researchers attempted to access reports from the remotely situated SPEARS device.

3.2.5.2 MOPS and Data Presentation.

MOP 26. The method of remote connection to the SPEARS device.

The TnT™ system evaluated was not capable of connecting with other systems in a network and electronically transmitting data. (See also MOP 25.) The same was true for the system used at the airport.

MOP 27. Demonstration of CTIs downloaded to the SPEARS device.

Not demonstrated. See MOP 26

MOP 28. Demonstration of FTIs downloaded to the SPEARS device.

Not demonstrated. See MOP 26

MOP 29. Time required to transfer a CTI.

Not demonstrated. See MOP 26

MOP 30. Time required to transfer an FTI.

Not demonstrated. See MOP 26.

MOP 31. The SPEARS remote performance monitoring capability.

Not demonstrated. See MOP 26

3.2.5.3 Analysis and Discussion.

This issue was judged not met since no capability was demonstrated for remote transmission.

3.2.6 Technical Issue 6: Security.

Is access restricted?

Criterion A. Only authorized screeners and supervisors can access certain aspects of the system.

3.2.6.1 Test Strategy.

The security issue was investigated though a combination of a structured checklist and a demonstration of security features. The security checklist is based on the *Department of Defense Trusted Computer System Evaluation Criteria* (DOD-5200.28-STD) and is contained in Appendix I.

3.2.6.2 MOPS and Data Presentation.

MOP 32. Computer Software Security Checklist results.

The TnT™ system allows only authorized operators and supervisors to access certain areas of the system. Each user has a unique identification number and identifiable password. The TnT™ does not provide sensitivity labels on their computer files because the system limits the propagation of sensitive information to authorized users and maintains an access audit trail. Further, the operating system is password protected, which eliminates all individuals from accessing screener information files and proprietary software files assuming the maintenance of password confidentiality. The proprietary software files are encrypted to prevent individuals from altering the programs.

3.2.6.3 Analysis and Discussion.

This issue was judged Met. The system is capable of maintaining files with restricted access to supervisors and requires all users to enter an appropriate password.

3.2.7 Technical Issue 7: Insertion.

Can FTI images be automatically and unpredictably (for screeners) inserted on the checkpoint X-ray display? Each FTI consists of only a single threat object.

Criterion A. FTI position can be randomly determined.

Criterion B. FTI orientation within each bag is controllable.

3.2.7.1 Test Strategy.

Baggage not containing threat objects were passed through the X-ray device and the SPEARS device used to insert FTIs onto the display of the bag image. For the bags that have FTIs inserted, the position of each threat image was noted on a 3 by 3 cell grid. The order of placement in each cell across FTIs was analyzed for randomness. An Image Insertion Checklist (Appendix K) was used to evaluate the proper insertion of images into the checkpoint X-ray display.

3.2.7.2 MOPS and Data Presentation.

MOP 33. Recording of presentation order for FTIs, and image threat placement for FTIs, using a baggage content locator matrix, which will be used to determine any predictable presentation patterns and FTI orientation controllability.

The TnT™ was able to generate FTIs (but not CTIs) using a computer generated threat object and a neutral passenger bag passing through the X-ray system. FTIs were generated automatically, but not by category. They had no apparent predictability of presentation. There are restrictions on the randomness of insertion position for the FTI since the image will be placed only where there is room for it in the bag. This led to some operational problems because the system occasionally displayed the FTI briefly in situations where the bag was too small to accommodate it. The FTI was then dropped from the bag image but screeners could tell that the system had tried to insert a FTI at that point. However, this was not responded to nor achieved.

3.2.7.3 Analysis and Discussion.

This issue was judged Met since images could be inserted with apparent unpredictability in bag images taking into account obvious physical constraints of bag and FTI size. However, the software bug which permits the FTI to occasionally be displayed while trying to insert it into a too small bag needs to be corrected.

# 4. CONCLUSIONS AND RECOMMENDATIONS.

## 4.1 SPEARS TRAINING.

The results from the ANOVAs and post-hoc analyses indicated that the TIP training produced no significant effect on training group performance ( IED $P_d$, $P_{fa}$, d', and c) on either of the posttests. Both groups showed a significant rise in d' over the course of the three tests but since the control group received no TIP, the increase must be ascribed to some general factor, such as LAX raised security levels around this time, test practice or increased motivation, rather than from the training. Post hoc analyses performed on TIP performance in the training group showed a one-time jump in performance between weeks 2 and 3 of the training and then a stabilization at

that new rate for the rest of the training. The results demonstrate that the training as provided by the system had no discernible effect on screener detection of IEDs.

## 4.2 SPEARS VIGILANCE.

A one time jump in the performance of the training group was observed between the second and third weeks of FTI exposure. This increase was sustained but not increased for the remainder of the treatments. These effects are consistent with an increase of vigilance caused by the treatment effect, however, there were external factors which provide a plausible alternative basis for the increase in hit rate, i.e. the increased security levels during that period of time at LAX due to specific threats. In addition, both the training and the control groups showed increased sensitivity on the first and second posttests compared with the pretest. An account based on FTI presentation alone cannot explain this finding since only the training group received the treatment.

## 4.3 SPEARS USABILITY ASSESSMENT.

Hardware, software, or procedural deficiencies noted are reported in Appendix B, along with any HF engineering recommendations for rectification. The difficulty in linking TIP presentations to particular individuals and the lack of timely and useful performance feedback are critical deficiencies which must be corrected. Other than that, the TnT™ had generally acceptable usability characteristics. The remaining deficiencies had a more modest impact on performance and usability of the system including no Help feature and poor text editing and menu navigation attributes.

## 4.4 TECHNICAL TEST AND EVALUATION.

The TnT™ system does not meet the majority of Technical Criteria established for it in the TEP. Out of 7 technical issues, the TnT™ only met 2 of them: Security and Image Insertion. The system was found deficient on Image Content, Customization, Feedback, Capability Summaries, and Interoperability. The system cannot present CTIs and had only 216 of the 300 required FTIs were available. It has poor feedback properties, no capacity for interoperability and very limited capacity for customization of FTI selection or the archiving process.

## 4.5 OVERALL CONCLUSION.

In its present configuration, the TnT™ system is not ready for operational use as a means of providing TIP to checkpoint screeners. Results from the operational test at LAX and from technical testing demonstrated that the TnT™ system did not meet the majority of approved critical operational and technical criteria specified in the Test and Evaluation Plan. The group receiving the TIP training showed no differential increase in screener sensitivity to target detection than did the control group over the course of the test trials.

These results indicate that it is not useful to administer TIP under conditions of limited accountability, intermittent exposure to the treatment, the absence of demonstrated mastery of the necessary skills to detect threats, or lack of knowledge of results. The inherent benefits of TIP exposure on screener performance may well have been masked by the difficulties in providing consistent and minimally necessary amounts of training to individuals in the training group as well as the other test constraints and system limitations described in the report.

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# SIGNAL DETECTION THEORY AND APPLICATION

# SIGNAL DETECTION THEORY AND APPLICATION

## SIGNAL DETECTION THEORY (SDT) PARADIGM.

The Improvised Explosive Device Detection System operation features human operators engaged in tasks to detect an environmental event or signal. SDT is a mathematical representation of human performance in deciding whether or not a signal is present. An operational example of SDT is an airport security guard screening passenger bags for concealed weapons and Improvised Explosive Devices (IEDs).

There are two response categories that represent a screener's detection performance: Yes (a Modular Bomb Set [MBS] signal was present) or No (an MBS signal was not present). There are also two signal presentation states indicating that the MBS signal was present (signal) or absent (noise). A combination of screener responses and the signal state produces a 2 x 2 matrix (figure A-1), generating four classes of operator responses, labeled hits, misses, false alarms, and correct rejections (Wickens 1992). Considering the Screener Proficiency Training Evaluation and Reporting System (SPEARS) Test and Evaluation:

| | | State of MBS Image | |
|---|---|---|---|
| | | MBS Present | MBS Not Present |
| Screener Response | Yes | Hit | False Alarm |
| | No | Miss | Correct Rejection |

FIGURE A-1. 2 X 2 MATRIX OF SCREENER RESPONSES AND STATE OF MBS IMAGE

a. A Hit will be recorded when a baggage screener correctly detects an MBS in the scanned baggage.

b. A False Alarm will be recorded when a baggage screener detects an MBS in the scanned baggage when none is present.

As indicated by Wickens (1992), the SDT paradigm assumes that operators perform two stages of information processing in all detection tasks: (1) sensory evidence is aggregated concerning the presence or absence of the signal, and (2) a decision is made about whether this evidence constitutes a signal. According to SDT, external stimuli generate neural activity in the brain. On the average, there will be more sensory or neural evidence in the brain when a signal is present than when it is absent. This neural evidence, X, referred to as the evidence variable, represents the rate of firing of neurons in the brain. The response rate for detecting X increases in magnitude with stimulus (signal) intensity. Therefore, if there is enough neural activity, X exceeds a critical threshold, $X_c$, and the operator decides "yes." If there is too little, the operator decides "no." Because the amount of energy in the signal is typically low, the average amount of X generated by signals in the environment is not much greater than the average generated when no signals are present (noise). Furthermore, the quantity of X varies continuously, even in the absence of a signal, because of random variations in the environment and the operator's level of neural firing (i.e., the neural "noise" in the operator's sensory channels and brain).

The relationship between the presence and absence of a signal can be seen in the hypothetical noise and signal plus noise distributions contained in figure A-2. The intersection of the two curves represents the location where the probability of a signal equals the probability of noise. The criterion value, $X_c$, chosen by the operator, is shown by the vertical line. All X values to the right ($X > X_c$) will cause the operator to respond "yes." All X values to the left generate "no" responses.

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FIGURE A-2. HYPOTHETICAL SDT DISTRIBUTIONS (Wickens 1992)

The different shaded areas represent the occurrences of hits, misses, false alarms, and correct rejections.

The procedures to calculate SDT probabilities are as follows:

a. In SDT, the detection values are expressed as probabilities.

b. The probability of hit ($P_h$), miss ($P_m$), false alarm ($P_{fa}$), and correct rejection ($P_{cr}$) are determined by dividing the number of occurrences in a cell (figure A-1) by the total number of occurrences in a column.

c. The $P_h$ (also referred as the probability of detection [$P_d$]) will be calculated by dividing the number of IEDs detected (number of hits) by the total number of hits and misses: $P_m = 1 - P_d$.

d. The $P_{fa}$ will be determined by the number of false alarms divided by the total number of false alarms and correct rejections: $P_{cr} = 1 - P_{fa}$.

<u>Operator Response Criterion</u>.

In any signal detection task, operator decision making may be described in terms of an operator response criterion. Operators may use "risky" response strategies by responding yes more often than no. A risky strategy allows operators to detect most of the signals that occur, but also produces many false alarms. Alternatively, operators may use "conservative" strategies, saying no most of the time, making few false alarms, but missing many of the signals.

Different circumstances may require conservative or risky strategies. For example, an appropriate IED detection strategy requires screeners to respond "yes" when there is a question regarding baggage contents. This response may produce false alarms when no threatening objects are present.

As shown in figure A-2, risky or conservative behavior is determined by the location of the operator's response criterion, $X_c$. If $X_c$ is placed to the right, much evidence of the signal is required for it to be exceeded and most responses will be "no" (conservative responding). If it is placed to the left, little signal evidence is required and most responses will be "yes," or "risky." A variable positively correlated with $X_c$ is the quantity beta ($\beta$), which is determined as follows:

$$\beta = \frac{ORD_H}{ORD_{FA}} \qquad (1)$$

This equation is the ratio of the ordinate of the two curves of figure A-2 at a given level of $X_c$. The higher $\beta$ values will generate fewer yes responses and, therefore, fewer hits. Lower $\beta$ settings will generate more yes responses, more hits, and more false alarms.

Table A-1 provides a representative table of Z values and ordinate values of the probability distribution related to hit and false alarm responses. A complete table of standard normal distribution values will be used to calculate β for the Test and Evaluation Report (TER).

TABLE A-1. REPRESENTATIVE Z-SCORES AND ORDINATE VALUES OF THE NORMAL CURVE FOR DIFFERENT RESPONSE PROBABILITIES TO CALCULATE β AND d′

| HIT/FA | Z | ORD | HIT/FA | Z | ORD |
|---|---|---|---|---|---|
| .01 | 2.33 | 0.03 | .50 | 0.00 | 0.40 |
| .02 | 2.05 | 0.05 | .55 | -0.12 | 0.40 |
| .03 | 1.88 | 0.07 | .60 | -0.25 | 0.39 |
| .04 | 1.75 | 0.09 | .65 | -0.38 | 0.37 |
| .05 | 1.64 | 0.10 | .70 | -0.52 | 0.35 |
| .08 | 1.40 | 0.15 | .75 | -0.67 | 0.32 |
| .10 | 1.28 | 0.18 | .80 | -0.84 | 0.28 |
| .13 | 1.13 | 0.21 | .82 | -0.92 | 0.26 |
| .15 | 1.04 | 0.23 | .85 | -1.40 | 0.23 |
| .18 | 0.92 | 0.26 | .88 | -1.18 | 0.20 |
| .20 | 0.84 | 0.28 | .90 | -1.28 | 0.18 |
| .25 | 0.67 | 0.32 | .92 | -1.40 | 0.15 |
| .30 | 0.52 | 0.35 | .95 | -1.64 | 0.10 |
| .35 | 0.38 | 0.37 | .96 | -1.75 | 0.09 |
| .40 | 0.25 | 0.39 | .97 | -1.88 | 0.07 |
| .45 | 0.12 | 0.40 | .98 | -2.05 | 0.05 |
| .50 | 0.00 | 0.40 | .99 | -2.33 | 0.03 |

The procedures required to calculate β are listed below (Coren and Ward 1989):

a. Find the false alarm rate from the outcome matrix in the HIT/FA column of table A-1.

b. Read across the table to the ORD column (for ordinate, the height of the bell curve).

c. Determine the value tabled there and write it down.

d. Repeat these operations for the hit rate.

e. Calculate β using the following equation: $\beta = ORD_h/ORD_{fa}$.

One recent parametric measure of response bias is $\underline{c}$ (Ingham 1970; Macmillan & Creelman 1990; and Snodgrass & Corwin 1988). The chief difference between the measure $\underline{c}$ and its parametric alternative β lies in the manner in which they locate the observer's criterion. Whereas the bias index β locates the observer's criterion by the ratio of the ordinates of the signal-plus - noise (SN) and noise (N) distributions, $\underline{c}$ locates the criterion by its distance from the intersection of the two distributions measured in z-score units. The intersection defines the point where bias is neutral, and location of the criterion at that point yields a $\underline{c}$ value of 0. Conservative criteria yield positive $\underline{c}$ values, and liberal criteria produce negative $\underline{c}$ values. The measure $\underline{c}$ is computed as follows:

$$\underline{c} = .5(z_{fa} + z_h) \tag{2}$$

Sensitivity (d′).

Sensitivity refers to the average amount of operator sensory activity generated by a given signal as compared with the average amount of noise-generated activity (Coren and Ward 1989). As explained earlier, baggage screeners may fail to detect (miss) an IED signal when employing a conservative β. Correspondingly, the signal may be missed because the resolution of the detection process is low in discriminating signals from noise, even if β is neutral or risky.

The perceptual analog of sensitivity, d′, corresponds to the separation of the means of signal and noise distributions (figure A-2). As the magnitude of the signal increases, the mean of the signal distribution moves to the right. The proportion of signals detected (the $P_d$) changes as the distance between the signal and noise distributions varies. According to Wickens (1992), if the separation between the distributions is great, sensitivity is great, an operator can readily distinguish a signal plus noise event from a noise only event. Similarly, if the separation between signal and noise is small, d′ measures will be low.

Table A-1 provides a representative table of Z values and ordinate values for the probability distribution related to hit and false alarm responses. A complete table of the ordinate values for the standard normal distribution will be used to calculate d′ for the TER.

The procedures required to calculate d′ are listed below (McNicol 1972).

a. Separate the data with respect to distribution (signal or noise), and total the data with respect to response (yes or no) and confidence rating (very sure or not very sure).

b. Calculate $P_d$ and $P_{fa}$ for each category.

c. Convert the values of $P_d$ and $P_{fa}$ to $z_d$ and $z_{fa}$ using the normal curve area.

d. Plot $z_d$ against $z_{fa}$ on a double-probability plot and determine the path of the ROC curve based upon the method of maximum likelihood.

e. Determine the ordinate value, for either axis, at which the ROC curve intersects with the negative diagonal. This value is equal to ½d′. Multiply this value by 2 for d′.

# SPEARS USABILITY HFE CHECKLIST

SPEARS USABILITY HFE CHECKLIST

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 1.0 Data Entry | | | | |
| 1. Users need enter data only once. | X | | | |
| 2. Display feedback for all user actions during data entry; display keyed entries stroke by stroke. | X | | | |
| 3. Provide fast response by the computer in acknowledging data entries. | X | | | |
| 4. Incorporate a consistent method for data change. | X | | | |
| 5. When critical data are to be processed, require an explicit "Enter" action to initiate the processing. | X | | | |
| 6. Provide feedback for the completion of data entry. | X | | | |
| 7. For repetitive data entry transactions, feedback should be the generation of or moving to the next data entry field. | NA | | | |
| 8. Choose defining abbreviations or other codes to shorten data entry that are distinctive to avoid confusion with one another. | NA | | | |
| 9. Allow users to enter each character of a data item with a single stroke of an appropriately labeled key. | X | | | |
| 10. Treat upper and lower case letters as equivalent. | X | | | |

| Human Factors Principle | Evaluation | | | Comments |
|---|---|---|---|---|
| | Acceptable | Acceptable with Deficiencies | Unacceptable | |
| 11. Treat single and multiple blank characters as equivalent in data entry; do not require users to count spaces. | X | | | |
| 12. For position designation on an electronic display, provide a movable cursor with distinctive visual features (shape, blink, etc.). | X | | | |
| 13. Design the cursor so that it does not obscure any other character displayed in the position designated by the cursor. | X | | | |
| 14. Ensure that the computer will acknowledge entry of a designated position quickly. | | | X | Trackball needed double-click to acknowledge entry. |
| 15. Ensure that the displayed cursor will be stable, i.e., that it will remain where it is placed until moved by the user (or by the computer) to another position. | X | | | |
| 16. When moving a cursor from one position to another, design the cursor control to permit both fast movement and accurate placement. | X | | | |
| 17. Ensure that control actions for cursor positioning are compatible with movements of the displayed cursor, in terms of control function and labeling. | X | | | |
| 18. If a cursor must be positioned sequentially in redefined areas, such as displayed data entry fields, ensure that this can be accomplished by simple user action. | | | X | In manager's/add operation sequence confusing - possible software anomoly |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 19. When there are areas of a display in which data entries cannot be made (blank spaces, protected field labels, etc.), make those areas insensitive to pointing actions, i.e., prevent the cursor from entering those areas. | X | | | |

| Human Factors Principle | Evaluation | | | Comments |
|---|---|---|---|---|
| | Acceptable | Acceptable with Deficiencies | Unacceptable | |
| 20. Ensure that an ENTER action for multiple data items results in entry of all items, regardless of where the cursor is placed on the display. | X | | | |
| 21. Ensure that display capacity, i.e., number of lines and line length, is adequate to support efficient performance of tasks. | X | | | |
| 22. When text has been specified to become the subject of control entries, highlight that segment of text in some way to indicate its boundaries. | | | X | Highlighting used inconsistently |
| 23. Unless otherwise specified by the user, ensure that entered text is left-justified, leaving right margins ragged if that is the result. | X | | | |
| 24. Allow users to select and move text from one place to another. | | | X | No cut/paste operation available |
| 25. Inform users concerning the status of requests for printouts. | NA | | | No printer available |
| 26. Design text editing logic so that any user action is immediately reversible. | X | | | |
| 27. An UNDO action should be able to reverse more than the most recent command. | | | X | No undo available - Also some screen navigation paths cannot be reversed. |
| 28. Make field labels consistent; always employ the same label to indicate the same kind of data. | X | | | |
| 29. Protect field labels from keyed entry. | X | | | |

| Human Factors Principle | Evaluation: Acceptable | Acceptable with Deficiencies | Unacceptable | Comments |
|---|---|---|---|---|
| 30. Ensure that labels are sufficiently close to be associated with their proper data fields, but are separated from data fields. | X | | | |
| 31. Choose a standard symbol for input prompting and reserve that symbol only for that use. | X | | | |
| 32. Clearly delineate each data field. | X | | | |
| 33. Provide cues in field delineation to indicate when a fixed maximum length is specified for a data entry. | | X | | The only feedback is that no additional entries can be made. |
| 34. Distinguish clearly and consistently between required and optional entry fields. | | | X | No distinctions made - Manual indicates optional data |
| 35. Provide automatic justification in computer processing; a user should not have to justify an entry either right or left. | X | | | |
| 36. Require users to take explicit keying ("tabbing") action to move from one data entry field to the next; the computer should not provide such tabbing automatically. | X | | | |
| 37. Make labels for data fields distinctive, so that they will not be readily confused with data or other displayed material. | X | | | |
| 38. In labeling data fields, employ descriptive working or standard, predefined terms, codes, and/or abbreviations; avoid arbitrary codes. | X | | | |
| 39. Include in a field label additional cueing of data format when that seems helpful. | X | | | |

| Human Factors Principle | Evaluation | | | Comments |
|---|---|---|---|---|
| | Acceptable | Acceptable with Deficiencies | Unacceptable | |
| 40. When a measurement unit is consistently associated with a particular data field, include that unit as part of the field label, rather than requiring a user to enter it. | X | | | |
| 41. Employ units of measurement that are familiar to the user. | X | | | OK for US users - possible problem for foreign users |
| 42. Order data items in the sequence in which a user will think of them. | X | | | |
| 43. The order of data items should represent a logical sequence of data entries. | X | | | |
| 44. When a form for data entry is displayed, the computer should place the cursor automatically at the beginning of the first entry field. | X | | | |
| 45. When sets of data items must be entered sequentially in a repetitive series, provide a tabular display format where data sets can be keyed row by row. | X | | X | OK on some machines |
| 46. Design distinctive formats for column headers and row labels, so that users can distinguish them from data entries. | X | | | |
| 47. Ensure that column headers and row labels are worded informatively, so that they will help guide data entry. | X | | | |
| 48. During tabular data entry, allow users to tab directly from one data field to the next, so that the cursor can move freely back and forth. | | X | | ADD OPERATORS - some fields are omitted from sequence |

| Human Factors Principle | Evaluation<br>Acceptable | <br>Acceptable with Deficiencies | <br>Unacceptable | Comments |
|---|---|---|---|---|
| 49. When a user must enter numeric values that will later be displayed, maintain all significant zeros; zeros should not be arbitrarily removed after a decimal point if they affect the meaning of the number in terms of significant digits. | NA | | | |
| 50. For entry of tabular data, when entries are frequently repeated, provide users with some easy means to copy duplicated data. | | | X | None available |
| 51. Provide users some means for designating and selecting displayed graphic elements for manipulation. When a user has changed or altered a displayed element, provide some indication so that other users will be aware of the consequences of that users actions. | | | | |
| 53. Ensure that every possible correct data entry will be accepted and processed properly by the computer. | | | X | Not all features were available |
| 54. If automatic data validation detects a probable error, display an error message to the user. If data validation from a secondary source detects a probable error, allow the primary user access to all functions required to check data accuracy. | X | | | |
| 55. If a user has deferred entry of required data, but then requests processing of entries, signal that omission to the user and allow immediate entry of missing items or perhaps further deferral. | X | | | |
| 56. If a set of default values have been defined for a data entry sequence, allow a user to accept all default entries. | NA | | | |

| Human Factors Principle | Evaluation | | | Comments |
|---|---|---|---|---|
| | Acceptable | Acceptable with Deficiencies | Unacceptable | |
| 57. When interface designers cannot predict what default values will be helpful, permit users (or a system administrator) to define, change, or remove default values for any data entry field. | | | X | Customize TnT feature was disabled on unit evaluated |
| 58. On initiation of a data entry transaction, display currently defined default values in their appropriate data fields. | X | | | |
| 59. Provide users with some simple means to confirm acceptance of a displayed default value for entry. | | | X | |
| 60. When data entries made in one transaction are relevant to a subsequent transaction, program the computer to retrieve and display them for user review, rather than requiring re-entry of those data. | X | | | |
| 61. Provide automatic cross-file updating whenever necessary, so that a user does not have to enter the same data twice. | X | | | |
| 2.0 Data Display | | | | |
| 1. Ensure that whatever data a user needs for any transaction will be available for display. | X | | | |
| 2. Tailor displayed data to user needs, providing only necessary and immediately usable data for any transaction; do not overload displays with extraneous data. | X | | | |
| 3. Display data to users in directly usable form; do not make users convert displayed data. | X | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 5. For any particular type of data display, maintain consistent format from one display to another. | X | | | |
| 6. Allow users to change displayed data or enter new data when that is required by a task. | X | | | |
| 7. When protection of displayed data is essential, maintain computer control over the display and do not permit a user to change controlled items. | X | | | |
| 8. Ensure that each data display will provide needed context, recapitulating prior data as necessary so that a user does not have to rely on memory to interpret new data. | X | | | |
| 9. The wording of displayed data and labels should incorporate familiar terms and the task-oriented jargon of the users. | | X | | IMAGE CAPTURED could be confusing |
| 10. Choose words carefully and then use them consistently. | X | | | |
| 11. Ensure that wording is consistent from one display to another. | | X | | use of word DONE in Image Library is inconsistent |
| 12. Use consistent grammatical structure within and across displays. | X | | | |
| 13. When abbreviations are used, choose those abbreviations that are commonly recognized, and do not abbreviate words that produce uncommon or ambiguous abbreviations. | | X | | 'c' for class - mm for minutes |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 14. Ensure that abbreviations are distinctive, so that abbreviations for different words are distinguishable. | X | | | |
| 15. Minimize punctuation of abbreviations and acronyms. | X | | | |
| 16. If abbreviations are used, provide a dictionary/glossary of abbreviations available for on-line user reference. | | | X | No online glossary |
| 17. When a critical passage merits emphasis to set it apart from other text, highlight that passage by bolding, brightening, color coding, or some auxiliary annotation. | | | | |
| 18. Organize data in some recognizable order to facilitate scanning and assimilation. | X | | | |
| 19. Display continuous test in wide columns, containing at least 50 characters per line. | NA | | | |
| 20. Display continuous text conventionally in mixed upper and lower case. | X | | | |
| 21. Ensure that displayed paragraphs of text are separated by at least one blank line. | X | | | |
| 22. Maintain consistent spacing between the words of displayed text, with left justification of lines and ragged right margins if that is the result. | X | | | |
| 23. In display of textual material, keep words intact, with minimal breaking by hyphenating between lines. | X | | | |

| Human Factors Principle | Evaluation: Acceptable | Acceptable with Deficiencies | Unacceptable | Comments |
|---|---|---|---|---|
| 24. Use conventional punctuation in textual display; sentences should end with a period or other special punctuation. | X | | | |
| 24. In designing text displays, especially text composed for user guidance, strive for simplicity and clarity of wording. | X | | | |
| 25. Put the main topic of each sentence near the beginning of the sentence. | X | | | |
| 26. Use short simple sentences. | X | | | |
| 27. Use affirmative statements rather than negative statements. | X | | | |
| 28. Compose sentences in the active voice rather than passive voice. | X | | | |
| 29. When a sentence describes a sequence of events, phrase it with a corresponding word order. | X | | | |
| 30. Format lists so that each item starts on a new line (i.e., a list should be displayed as a single column). | X | | | |
| 31. When a single item in a list continues for more than one line, mark items in some way so that the continuation of an item is obvious (i.e., so that a continued portion does not appear to be a separate item). | X | | | |
| 32. When listed items will be numbered, use Arabic rather than Roman numerals. | X | | | |

| Human Factors Principle | Evaluation | | | Comments |
|---|---|---|---|---|
| | Acceptable | Acceptable with Deficiencies | Unacceptable | |
| 33. Adopt some logical principle by which to order lists. When no other principle applies, order lists alphabetically. | X | | | |
| 34. If a list is displayed in multiple columns, order the items vertically within each cell. | X | | | |
| 35. For a long list, extending more than one displayed page, consider adopting a hierarchic structure to permit its logical partitioning into related shorter lists. | NA | | | |
| 36. When words in text displays are abbreviated, define each abbreviation in parentheses following its first appearance. | NA | | | None |
| 37. When text is combined with graphics or other data in a single display, thus limiting the space available for text, format the text in a few wide lines rather than in narrow columns of many short lines. | X | | | |
| 38. Separate the data in a table by some distinctive feature, to ensure separations of entries within a row. | X | | | |
| 39. In dense tables with many rows, insert a distinctive feature to aid horizontal scanning at regular intervals. | X | | | |
| 40. Ensure that row and column labels are distinguishable from the data displayed within tables and from the labels of displayed lists, such as menu options or instructions to users. | X | | | |
| 41. When rows or columns are labeled by number, start the numbering with "1," rather than "0." | X | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 42. Show columns of alphabetic data with left justification to permit rapid scanning. | X | | | |
| 43. Justify columns of numeric data with respect to a fixed decimal point; if there is no decimal point, then numbers should be right justified. | X | | | |
| 44. Use consistent logic in the design of graphic displays, and maintain standard format, labeling, etc. | X | | | |
| 45. Tailor graphic displays to user needs and provide only those data necessary for user tasks. | X | | | |
| 46. When graphics contain outstanding or discrepant features that merit attention by a user, consider displaying supplementary text to emphasize that feature. | X | | | |
| 47. When a user's attention must be directed to a portion of a display showing critical or abnormal data, highlight that feature with some distinctive means of coding. | | | X | No use of effective highlight |
| 48. Adopt a consistent organization for the location of various display features from one display to another. | X | | | |
| 49. Make the different elements of a display format distinctive from one another. | | X | | |
| 50. Use blank space to structure a display. | X | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 51. Begin every display at the top with a title or header, describing briefly the contents or purpose of the display. | X | | | |
| 52. Reserve the last several lines at the bottom of every display for status and error messages, prompts, and command entry. | | | X | Not done |
| 53. Ensure that displays are formatted to group data items on the basis of some logical principle. | X | | | |
| 54. Provide distinctive coding to highlight important display items requiring user attention. Highlighting is most effective when used sparingly. | | | X | No effective use of highlighting |
| 55. If highlighting is used to emphasize important display items, remove such highlighting when it no longer has meaning. | X | | | |
| 56. Adopt meaningful or familiar codes, rather than arbitrary codes. | X | | | |
| 57. Adopt codes for display (and entry) that conform with accepted abbreviations and general user expectations. | X | | | |
| 58. Assign consistent meanings to symbols and other codes, from one display to another. | X | | | |
| 59. Treat brightness as a two-valued code, bright and dim, i.e., consider coding by difference in brightness for applications that only require discriminating between two categories of displayed items. | | X | | Not effectively used |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 60. Color code for relative values. | | | X | Colors are meaningless on graphs |
| 61. It will prove safer to use no more than five different colors for coding. | | | X | |
| 62. When selecting colors for coding discrete categories of data, ensure that those colors are easily discriminable. | X | | | |
| 63. Employ color coding conservatively, using relatively few colors and only to designated critical categories of displayed data. | | | X | |
| 64. Make color coding redundant with some other display feature, such as symbology; do not code only by color. | X | | | |
| 65. When color coding is used, ensure that each color represents only one category of displayed data. | X | | | |
| 66. Choose colors for coding based on conventional associations with particular colors. | | | X | |
| 67. Use brighter and/or more saturated colors when it is necessary to draw a user's attention to critical data. | | | X | Not used |
| 68. Use saturated blue only for background features in a display, and not for critical coding. | X | | | |
| 69. When blink coding is used, select a blink rate in the rage from 2 to 5 Hz, with a minimum duty cycle (ON interval) of 50 percent. | NA | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 70. When data have changed, especially following automatic display update, consider highlighting those data changes temporarily. | | | X | Not used |
| 71. When standard data displays are used for special purposes, allow users to temporarily suppress the display of data. | | | X | Not allowed |
| 3.0 Sequence Control | | | | |
| 1. Defer computer processing until an explicit user action has been taken. | X | | | |
| 2. Employ similar means to accomplish ends that are similar, from one transaction to the next, from one task to another, throughout the user interface. | X | | | |
| 3. Display some continuous indication of current context for reference by the user. | X | | | |
| 4. Adopt consistent terminology for on-line guidance and other messages to users. | X | | | |
| 5. Choose names that are semantically congruent with natural usage, especially for paired opposites (e.g., UP / DOWN). | X | | | |
| 6. Ensure that the computer acknowledges every entry immediately; for every action by the user there should be some apparent reaction from the computer. | | | X | Feedback on operators first screen is missing |
| 7. Each menu display should permit only one selection by the user. | X | | | |

| Human Factors Principle | Evaluation: Acceptable | Acceptable with Deficiencies | Unacceptable | Comments |
|---|---|---|---|---|
| 8. When multiple menu options are displayed in a list, display each option on a new line, i.e., format the list as a single column. | X | | | |
| 9. When a user has selected and entered an option from a menu, if there is no immediately observable natural response, then the computer should display some other acknowledgment of that entry. | | X | | - Change of pages in image library is difficult to detect<br>- ID # entry is not confirmed |
| 10. Display an explanatory title for each menu, reflecting the nature of the choice to be made. | X | | | |
| 11. Design a menu to display all options appropriate to any particular transaction. | X | | | |
| 12. Design a menu to display only those options that are actually available in the current context for a particular user. | X | | | |
| 13. When menus are provided in different displays, design them so that option lists are consistent in wording and ordering. | X | | | |
| 14. If menu options are included in a display that is intended for data review and/or data entry, ensure that they are distinct from other displayed information; incorporate some consistent distinguishing feature to indicate their special function. | X | | | |
| 15. List displayed menu options in a logical order; if no logical structure is apparent, then display the options in the order of their expected frequency of use, with the most frequent listed first. | X | | | |

| Human Factors Principle | Evaluation: Acceptable | Acceptable with Deficiencies | Unacceptable | Comments |
|---|---|---|---|---|
| 16. Format a menu to indicate logically related groups of options, rather than as an undifferentiated string of alternatives. | NA | | | |
| 17. When the menu selection must be made from a long list, and not all options can be displayed at once, provide a hierarchic sequence of menu selections, rather than one long multipage menu. | NA | | | |
| 18. When hierarchic menus are used, design their structure to permit immediate user access to critical or frequently selected options. | NA | | | |
| 19. When hierarchic menus are used, display some indication of current position in the menu structure.. | NA | | | |
| 20. When hierarchic menus are used, ensure that display format and selection logic are consistent at every level. | NA | | | |
| 21. When hierarchic menus are used, require users to take only one simple key action to return to the next higher level. | NA | | | |
| 22. When hierarchic menus are used, require users to take only one simple key action to return to the general menu at the top level. | NA | | | |
| 23. Design the general options list to show control entry options grouped, labeled, and ordered in terms of their logical function, and frequency and criticality of use. | NA | | | |
| 24. Make available to users a list of the control options that are specifically appropriate for any transaction. | NA | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 25. Offer users only control options that are actually available for the current transactions. | X | | | |
| 26. When a user is performing an operation on some selected display item, highlight that item. | | X | | Highlighting rarely used |
| 27. Design the interface software to deal appropriately with all possible control entries, correct and incorrect. | | X | | |
| 28. When a user completes correction of an error, require the user to take an explicit action to reenter the corrected material; use the same action for reentry that was used for the original entry. | X | | | |
| 29. When a control entry will cause any extensive change in stored data, procedures, and/or system operation, and particularly if that change cannot be easily reversed, notify the user and require confirmation of the action before implementing it. Provide a prompt to confirm actions that will lead to possible data loss. | | | X | All features not available |
| 30. Word the prompt for a CONFIRM action to warn users explicitly of any possible data loss. | | | | |
| 31. Ensure that any user action can be immediately reversed by an UNDO command. | | | | |
| 32. UNDO itself should be reversible, so that a second UNDO action will do again whatever was just undone. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
| --- | --- | --- | --- | --- |
| 33. When a user requests LOG-OFF, check pending transactions and, if any pending transaction will not be completed or if data will be lost, display an advisory message requesting user confirmation. Ensure that the user is aware of the status of the system or any of its components after LOG-OFF is complete. | | | | |
| 4.0 User Guidance | | | | |
| 1. Design standard procedures for accomplishing similar, logically related transactions. | | | | |
| 2. Require users to take explicit actions to specify computer processing; the computer should not take extra actions beyond those specified by a user. | | | | |
| 3. In applications where users must log on to the system, design LOG-ON as a separate procedure that is completed before a user is required to select among any operational options. | | | | |
| 4. Ensure that only relevant data are displayed by tailoring the display for any transaction to the current information requirements of the user. | | | | |
| 5. Create display formats with a consistent structure evident to the user, so that a particular type of data is always presented in the same place and in the same way. | | | | |
| 6. Format each different type of user guidance consistently across displays. | | | | |

| Human Factors Principle | Evaluation | | | Comments |
|---|---|---|---|---|
| | Acceptable | Acceptable with Deficiencies | Unacceptable | |
| 7. Design display formats so that user guidance material is readily distinguishable from displayed data. | | | | |
| 8. Design cursors so that they are readily distinguished from other displayed items. | | | | |
| 9. Label all displayed data clearly. | | | | |
| 10. Ensure that symbols and other codes have consistent meanings from one display to another. | | | | |
| 11. Ensure that the names for functions and data are consistent for similar or identical functions. | | | | |
| 12. Adopt wording terminology familiar to users. | | | | |
| 13. Adopt task-oriented wording. | | | | |
| 14. Adopt affirmative rather than negative wording for user guidance messages. | | | | |
| 15. Adopt active rather than passive voice in user guidance messages. | | | | |
| 16. When user guidance describes a sequence of steps, follow that same sequence in the wording of user guidance. | | | | |
| 17. Be consistent in grammatical construction when wording user guidance. | | | | |
| 18. Allow users to switch easily between information handling and associated guidance material. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 19. Provide some indication of system status to users at all times. | | | | |
| 20. When users must log on to a system, display appropriate prompts for LOG-ON procedures automatically at a user's terminal. | | | | |
| 21. If a user tries to log onto a system and LOG-ON is denied because of system unavailability, display an advisory message telling the user what the system status is and when the system will become available. | | | | |
| 22. When task performance requires data exchange and/or interaction with other users, allow a user to obtain status information concerning other people currently using the system. | | | | |
| 23. Ensure that every input by a user will consistently produce some perceptible response output from the computer. | | | | |
| 24. Ensure that computer response to user entries will be rapid, with consistent timing as appropriate for different types of transactions. | | | | |
| 25. Provide some indication of transaction status whenever the complete response to a user entry will be delayed. | | | | |
| 26. Provide a unique identification for each display in a consistent location at the top of the display frame. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 27. When a user (or computer) action establishes a change in operational mode that will affect subsequent user actions, display some continuing indication of current mode. | | | | |
| 28. When the computer detects an entry error, display an error message to the user stating what is wrong and what can be done about it. | | | | |
| 29. Make the wording of error messages as specific as possible. | | | | |
| 30. Make error messages brief but informative. | | | | |
| 31. Adopt neutral wording for error messages; do not imply blame to the user, or personalize the computer, or attempt to make a message humorous. | | | | |
| 32. The computer should display an error message only after a user has completed an entry. | | | | |
| 33. Display an error message a minimum of 2 to 4 seconds after the user entry in which the error is detected. | | | | |
| 34. As a supplement on-line guidance, include in the system documentation listing and explaining all error messages. | | | | |
| 35. In addition to providing an error message, mark the location of a detected error by positioning the cursor at that point on the display, i.e., at that data field or command word. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 36. When an entry error has been detected, continue to display the erroneous entry, as well as an error message, until corrections are made. | | | | |
| 37. Following error detection, require the user to reenter only that portion of a data/command entry which is not correct. | | | | |
| 38. Ensure that a displayed error message is removed after the error has been corrected; do not continue to display a message that is no longer applicable. | | | | |
| 39. Ensure that specific user guidance information is available for display at any point in a transaction sequence. | | | | |
| 40. Display menu options in logical groups. | | | | |
| 41. Provide reference material describing system capabilities and procedures available to users for on-line display. | | | | |
| 42. In addition to explicit and implicit aids, permit users to obtain further on-line guidance by requesting HELP. | | | | |
| 43. Provide a simple, standard action that is always available to request HELP. | | | | |
| 44. When an initial HELP display provides only summary information, provide more detailed explanations in response to repeated user requests for HELP. | | | | |

| Human Factors Principle | Evaluation | | | Comments |
|---|---|---|---|---|
| | Acceptable | Acceptable with Deficiencies | Unacceptable | |
| 45. Permit users to browse through on-line HELP displays, just as they would through a printed manual, to gain familiarity with system functions and operating procedures. | | | | |
| 5.0 Data Transmission | | | | |
| 1. Choose functional wording for terms used in data transmission, including messages, for initiating and controlling message transmission and other forms of data transfer, and for receiving messages. | | | | |
| 2. Design the data transmission procedures to minimize memory load on the user. | | | | |
| 3. Design the data transmission procedures to minimize required user actions. | | | | |
| 4. Design the data transmission procedures so that both sending and receiving messages are accomplished by explicit user action. | | | | |
| 5. Allow users to interrupt message preparation, review, or disposition, and then resume any of those tasks from the point of interruption. | | | | |
| 6. Provide software capabilities to annotate transmitted data with appropriate highlighting to emphasize alarm/alert conditions, priority indicators, or other significant second-order information that could affect message handling. | | | | |

| Human Factors Principle | Evaluation | | | Comments |
|---|---|---|---|---|
| | Acceptable | Acceptable with Deficiencies | Unacceptable | |
| 7. For addressing and identifying messages, provide a basic set of header fields that can be interpreted by all systems to which users will send messages. | | | | |
| 8. Allow users to print copies of transmitted messages in order to make hard-copy records. | | | | |
| 9. Ensure that transmitted data are protected automatically with parity checks to detect and correct any errors that may occur, and buffering until acknowledgment of receipt. | | | | |
| 10. Ensure that only one copy of a message will be transmitted to any individual addressee. | | | | |
| 11. For receiving messages, allow users to choose the method of receipt (i.e., files, display, printer) that will be the local destination. | | | | |
| 12. Ensure that computer aids and procedures for reviewing messages are consistent with other system capabilities for general data display. | | | | |
| 6.0 Data Protection | | | | |
| 1. Provide automatic measures to minimize data loss from computer failure. | | | | |
| 2. Protect data from inadvertent loss caused by the actions of other users. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 3. Provide clear and consistent procedures for different types of transactions, particularly those involving data entry, change and deletion, and error correction. | | | | |
| 4. Ensure that the ease of user actions will match desired ends; make frequent or urgent actions easy to take, but make potentially destructive actions sufficiently difficult that they will require extra user attention. | | | | |
| 5. Ensure that the computer changes data only as a result of explicit actions by a user, and does not initiate changes automatically. | | | | |
| 6. For conditions which may require special user attention to protect against data loss, provide an explicit alarm and/or warning message to prompt appropriate user action. | | | | |
| 7. Allow users to UNDO an immediately preceding control action that may have caused an unintended data loss. | | | | |
| 8. Design the LOG-ON process and procedures for user identification to be as simple as possible and consistent with protecting data from unauthorized use. | | | | |
| 9. Design the LOG-ON process to provide prompts for all user entries, including passwords and/or whatever other data are required to confirm user identity and to authorize appropriate data access/change privileges. | | | | |
| 10. When passwords are required, allow users to choose their own passwords. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 11. Allow users to change their passwords whenever they choose. | | | | |
| 12. When a password must be entered by a user, ensure that password entry can be private; password entries should not be displayed. | | | | |
| 13. Impose a maximum limit on the number and rate of unsuccessful LOG-ON attempts that will provide a margin for user error while protecting the system from persistent attempts at illegitimate access. | | | | |
| 14. Once a user's identity has been authenticated, ensure that whatever data access/change privileges are authorized for that user will continue throughout a work session. | | | | |
| 15. Establish user authorization for data access at initial LOG-ON; do not require further authentication when a user requests display of particular data. | | | | |
| 16. When displayed data are classified for security purposes, include a prominent indication of security classification in each display. | | | | |
| 17. When confidential information is displayed at a work station that might be viewed by casual onlookers, provide the user with some rapid means of temporarily suppressing a current display, and then resuming work later. | | | | |
| 18. When data must not be changed, maintain computer control over the data, and do not permit users to change controlled items. | | | | |

| Human Factors Principle | Evaluation | | | Comments |
|---|---|---|---|---|
| | Acceptable | Acceptable with Deficiencies | Unacceptable | |
| 19. Make procedures for data entry/change as simple as possible. | | | | |
| 20. Allow users to enter logically related items with a single, explicit action at the end of the sequence, rather than entering each item separately. | | | | |
| 21. When a data entry error is detected by the computer, allow the user to make an immediate correction. | | | | |
| 22. Following error detection, allow users to edit entries so that they must rekey only those portions that were in error. | | | | |
| 23. Require users to take explicit action to confirm doubtful and/or potentially destructive data change actions before they are accepted by the computer for execution. | | | | |
| 24. When a user requests LOG-OFF, check pending transactions involving data entry/change and, if data loss seems probable, display an appropriate advisory message to the user. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 7.0 Hardware (MIL-STD 1472D) | | | | |
| Visual Displays | | | | |
| 1.0 Contrast. Sufficient contrast shall be provided between displayed information and the display background to ensure that the required information can be perceived by the operator under all expected lighting conditions. | | | | |
| 2.0 Location. Displays shall be located and designed so that they may be read to the degree of accuracy required by personnel in normal operating or servicing positions without requiring the operator to assume an uncomfortable, awkward, or unsafe position. | | | | |
| 3.0 Orientation. Display faces shall be perpendicular to the operator's normal line of sight whenever feasible and shall not be less than 3.14/4 rad (45°) from the normal line of sight. | | | | |
| 4.0 Reflection. Displays shall be constructed, arranged, and mounted to prevent reduction of information transfer due to the reflection of the ambient illumination from the display cover. Reflection of instruments and consoles and other enclosures shall be avoided. | | | | |
| 5.0 Frequency of use. Displays used most frequently should be grouped together and placed in the optimum visual zone. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| CRTs | | | | |
| 1.0 Viewing distance. A 400 mm (16-inch) viewing distance shall be provided whenever practicable. When periods of observation will be short, or when dim signals must be detected, the viewing distance may be reduced to 250 mm (10 inches). Design should permit the observer to view the CRT as close as desired. | | | | |
| 2.0 Reflected glare. Reflected glare shall be minimized by proper placement of the CRT relative to the light source and the use of a hood, shield, or optical coating on the CRT. | | | | |
| 3.0 Ambient surfaces. Surfaces adjacent to the CRT shall have a dull matte finish. | | | | |
| 4.0 Font legibility. Where alphanumeric characters appear on CRT-like displays, the font style shall allow discrimination of similar characters, such as the letter l and the number 1 and the letter z and the number 2. | | | | |
| Audio Displays | | | | |
| 1.0 Type of voice. The voice used in recording verbal signals shall be distinctive and mature. | | | | |
| 2.0 Delivery style. Verbal signal shall be presented in a formal, impersonal manner. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 3.0 Message content. In selecting words to be used in audio warning signals, priority shall be given to intelligibility, aptness, and conciseness in that order. | | | | |
| 4.0 Volume control (automatic or manual). The volume (loudness) of an audio warning signal shall be designated to be controlled by the operator, the sensing mechanism, or both. | | | | |
| Keyboards | | | | |
| 1.0 Numeric keyboard. The configuration of a keyboard used to enter solely numeric information should be a 3 x 3 + 1 matrix with the zero digit centered on the bottom row. | | | | |
| 2.0 Alpha-numeric keyboard. Keyboard configurations for entry of alphabetic and some numeric information shall conform to MIL-STD-1280. | | | | |
| 3.0 Slope. The slope of nonportable keyboards should be 260-435 mrad (15-25°) from the horizontal. The preferred slope is 280-300 mrad (17-18°). | | | | |
| 4.0 Resistance. The force required to operate alphanumeric or numeric keyboards shall conform to figure 11, page 91, and table X, page 95, MIL-STD-1472D. | | | | |
| Touch Screen | | | | |
| 1.0 The dimensions and separation of responsive areas of the touch screen shall conform to S1, S2, and S3 of figure 14, page 119, MIL-STD-1472D. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 2.0 Resistance. The force required to operate force-actuated touch-screens shall conform to the alphanumeric resistance limits of table 11, page 91, MIL-STD-1472D. | | | | |

| | | | | |
|---|---|---|---|---|
| Equipment Labeling | | | | |
| 1.0 Location. The gross identifying label on a unit, assembly, or major subassembly shall be located externally, in such a position that it is not obscured by adjacent items; on the flattest, most uncluttered surface available; and on a main chassis of the equipment. | | | | |
| 2.0 Functional labeling. Each control and display shall be labeled according to function, and the following criteria shall apply: (a) similar names for different controls and displays shall be avoided; (b) instruments shall be labeled in terms of what is being measured or controlled, taking into account the user and purpose; (c) control labeling shall indicate the functional result of control movement (e.g., on, off); (d) when controls and displays must be used together (in certain adjustment tasks), appropriate labels shall indicate their functional relationship -- the selection and use of terminology shall be consistent. | | | | |
| 3.0 Location. (a) Ease of control operation shall be given priority over visibility of labels; (b) labels would normally be placed above the controls and displays they describe. When the panel is above eye level, labels may be located below if label visibility will be enhanced. | | | | |
| Workspace Design | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 1.0 Kick space. All cabinets, consoles, and work surfaces that require an operator to stand or sit close to their front surfaces shall contain a kick space at the base at least 100 mm (4 inches) deep and 100 mm (4 inches) high. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| Standing Operations | | | | |
| 1.0 Work surface. Work surfaces designed to support manual, worksheets, etc., shall be 915 +/- mm (36 +/- 0.6 inches) above the floor. | | | | |
| 2.0 Display placement, normal. Visual displays mounted vertically and used in normal equipment operation shall be placed between 1.040 m (41 inches) and 1.780 m (70 inches) above the standing surface. | | | | |
| Seated Operations | | | | |
| 1.0 Work surface width and depth. A lateral workspace of at least 760 mm (30 inches) wide and 400 mm (16 inches) deep shall be provided whenever practicable. | | | | |
| 2.0 Work surface height. Desk tops and writing tables shall be 740 to 790 mm (29 to 31 inches) above the floor. | | | | |
| Standard Console Design | | | | |

| Human Factors Principle | Evaluation | | | Comments |
|---|---|---|---|---|
| | Acceptable | Acceptable with Deficiencies | Unacceptable | |
| 1.0 Dimensions. Consoles which constitute operator workstations should be designed to conform with the dimensions shown in table XX and figure 30, pages 154-155, MIL-STD-1472D. | | | | |
| 2.0 Viewing angle. The total required left-to-right viewing angle shall not exceed 190 degrees (see figure 2, MIL-STD-1472D). This angle should be reduced whenever possible through appropriate control-display layout. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| Accessibility | | | | |
| 1.0 Structural members. Structural members or permanently installed equipment shall not visually or physically obstruct adjustment, servicing, removal of replacement equipment, or other required maintenance tasks. Panels, cases, and covers removed to access equipment shall have the same access requirements as replaceable equipment. Mounting provisions shall be visually and physically accessible by the maintainers. No special tools shall be required for removal or replacement, unless required by security considerations. | | | | |
| 2.0 Large items. Large items which are difficulty to remove shall be mounted so that they will not prevent convenient access to other items. | | | | |
| 3.0 Use of tools and test equipment. Sufficient space shall be provided for the use of test equipment and other required tools without difficulty or hazard. | | | | |
| 4.0 Rear access. Sliding, rotating, or hinged equipment to which rear access is required shall be free to open or rotate their full distance or remain in the open position without being supported by hand. | | | | |
| 5.0 Relative accessibility. Mission critical items which require rapid maintenance shall be most accessible. When relative criticality is not a factor, items requiring most frequent access shall be most accessible. | | | | |

| Human Factors Principle | Evaluation: Acceptable | Evaluation: Acceptable with Deficiencies | Evaluation: Unacceptable | Comments |
|---|---|---|---|---|
| 6.0 Skills. Access to items maintained by one technician should not require removal of critical equipment maintained by another technician, particularly where highly specialized skills are involved. | | | | |
| Covers | | | | |
| 1.0 Securing covers. It shall be made obvious when a cover is not secured, even though it may be in place. | | | | |
| 2.0 If the method of opening a cover is not obvious from the construction of the cover itself, instructions shall be permanently displayed on the outside of the cover. Instructions shall consist of simple symbols such as arrows or simple words such as "push" or "pull." | | | | |
| 3.0 Clearance. Bulkheads, brackets, and other equipment shall not obstruct visual or physical access for removal or opening of covers on equipment within which work must be performed in the installed condition. Covers, doors, or panels which must be opened to perform on-site maintenance shall be visually and physically accessible to the maintainers. | | | | |

# SPEARS OT&E SCREENER USABILITY RATINGS

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| 11. The SPEARS machine helped me to understand when I made the right and wrong decision about whether there was an explosive device in a bag. | 1 | 2 | 3 | 4 | 5 |
| 12. The SPEARS machine did not slow down the movement of baggage and passengers. | 1 | 2 | 3 | 4 | 5 |
| 13. The SPEARS machine did not interfere with the performance of my tasks. | 1 | 2 | 3 | 4 | 5 |
| 14. The SPEARS machine is conveniently located. | 1 | 2 | 3 | 4 | 5 |
| 15. The SPEARS machine x-ray enhancement buttons improved my ability to detect explosive devices. | 1 | 2 | 3 | 4 | 5 |

| Not at all | | | | Very much so |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| 1. The SPEARS TIP training and testing improved my ability to detect explosive devices. | 1 | 2 | 3 | 4 RL | 5 |
| 2. The SPEARS TIP training and testing will help me on my job. | 1 | 2 | 3 | 4 | 5 |
| 3. I enjoyed taking the SPEARS TIP training and testing. | 1 | 2 | 3 | 4 | 5 |
| 4. I would like to continue this training in my work. | 1 | 2 | 3 | 4 | 5 |
| 5. The SPEARS TIP function is easy to operate. | 1 | 2 | 3 | 4 | 5 |
| 6. The TIP key is easy to locate and depress. | 1 | 2 | 3 | 4 | 5 |
| 7. The SPEARS machine showed me explosive images I had never seen before. | 1 | 2 | 3 | 4 | 5 |
| 8. The false explosive images look like real x-ray images of explosive devices. | 1 | 2 | 3 | 4 | 5 |
| 9. I could not guess when I would get a false explosive image from the SPEARS. | 1 | 2 | 3 | 4 | 5 |
| 10. The SPEARS generated reports were understandable. | 1 | 2 | 3 | 4 | 5 |
| 11. The SPEARS machine helped me to understand when I made the right and wrong decision about whether there was an explosive device in a bag. | 1 | 2 | 3 | 4 | 5 |
| 12. The SPEARS machine did not slow down the movement of baggage and passengers. | 1 | 2 | 3 | 4 | 5 |
| 13. The SPEARS machine did not interfere with the performance of my tasks. | 1 | 2 | 3 | 4 | 5 |
| 14. The SPEARS machine is conveniently located. | 1 | 2 | 3 | 4 | 5 |
| 15. The SPEARS machine x-ray enhancement buttons improved my ability to detect explosive devices. | 1 | 2 | 3 | 4 | 5 |

# SPEARS IMAGE CONTENT CHECKLIST

SPEARS IMAGE CONTENT CHECKLIST

| | Evaluation | | |
|---|---|---|---|
| SPEARS Image Content | Yes | No | Comments/Description |
| 1. The number of images of CTIs provided by the system is _____. | NA | NA | |
| 2. The number of images of FTIs provided by the system is _____. | NA | NA | |
| 3. The number of CTIs of weapons is _____. | NA | NA | |
| 4. The number of CTIs of explosives is _____. | NA | NA | |
| 5. The number of CTIs of incendiary devices is _____. | NA | NA | |
| 6. The number of CTIs of dangerous/deadly devices other than weapons, incendiaries or explosives is _____. | NA | NA | |
| 7. The number of FTIs of weapons is ____. | NA | NA | 89 +7 FAA test obj. = 96 |
| 8. The number of FTIs of explosives is _____. | NA | NA | Explosives = 65<br>Components = 55 |
| 9. The number of FTIs of dangerous/deadly devices other than weapons, incendiaries or explosives is _____. | NA | NA | |
| 10. At least two different aspect angles are available for each CTI presentation. | NA | NA | |
| 11. At least two different aspect angles are available for each FTI presentation. | X | | |

# SPEARS CUSTOMIZATION CHECKLIST

SPEARS CUSTOMIZATION CHECKLIST

| | Evaluation | | |
|---|---|---|---|
| SPEARS Customization | Yes | No | Comments/Description |
| 1. Combined Threats and Images (CTIs) can be selected for each screener as a function of threat category. | | X | |
| 2. CTIs can be selected for each screener as a function of difficulty. | | X | |
| 3. CTIs can be selected for each screener as a function of aspect angle. | | X | |
| 4. CTIs can be selected as a function of the combination of threat category, screener difficulty, and aspect angle. | | X | |
| 5. CTIs can be archived with the associated screener outcome ( hit, miss, false alarm, and correct rejection). | | X | |
| 6. Each archived CTI with associated screener trial outcome includes date and time of day. | | X | |
| 7. Fictional Threat Images (FTIs) can be selected for each screener as a function of threat category. | | X | |
| 8. FTIs can be selected for each screener as a function of difficulty. | | X | |
| 9. FTIs can be selected for each screener as a function of aspect angle. | | X | |

| | Evaluation | | |
|---|---|---|---|
| SPEARS Customization | Yes | No | Comments/Description |
| 10. FTIs can be selected as a function of the combination of threat category, screener difficulty, and aspect angle. | | X | |
| 11. FTIs can be archived with the associated screener outcome (hit, miss, false alarm, correct rejection). | X | | |
| 12. Each archived FTI with associated screener trial outcome includes date and time of day. | X | | |
| 13. CTIs can be automatically or manually selected based on time of day. | | X | |
| 14. CTIs can be automatically or manually selected based on checkpoint activity. | | X | |
| 15. CTIs can be automatically or manually selected based on screener identity. | | X | |
| 16. CTIs can be automatically or manually selected based on the combination of time of day, checkpoint activity, and screener identity. | | X | |
| 17. FTIs can be automatically or manually selected based on time of day. | X | | |
| 18. FTIs can be automatically or manually selected based on checkpoint activity. | | X | |
| 19. FTIs can be automatically or manually selected based on screener identity. | | X | |

| | Evaluation | | |
|---|---|---|---|
| SPEARS Customization | Yes | No | Comments/Description |
| 20. FTIs can be automatically or manually selected based on the combination of time of day, checkpoint activity, and screener identity. | | X | |

# SPEARS FEEDBACK CHECKLIST

SPEARS FEEDBACK CHECKLIST

| | Evaluation | | |
|---|---|---|---|
| SPEARS Feedback | Yes | No | Comments/Description |
| 1. Feedback is immediate after correct, incorrect, or missed identification of an FTI. | | X | Slow - Missed threats are not identified and/or disappear too quickly |
| 2. Feedback is displayed in a consistent position. | X | | |
| 3. Feedback is consistent in terms of format and content. | X | | |
| 4. Feedback is provided for correct FTI identification. | X | | |
| 5. Feedback is provided for missed FTI identification. | | X | The actual FTI disappears too quickly |
| 6. Following missed FTI identification, the location of the missed FTI is provided on the display. | | X | |
| 7. Feedback is provided for threat items that do not contain threat images. | X | | |
| 8. FTIs are removed from the display to allow additional image scanning. | X | | Operators indicate image removal is too slow |
| 9. The time interval between user initiation and system feedback for each condition of correct or missed identification, image removal, and threat items which do not contain threat images is _____. | NA | NA | |

| | Evaluation | | |
|---|---|---|---|
| SPEARS Feedback | Yes | No | Comments/Description |
| 10. The nature of the feedback (i.e., visual and/or auditory, graphical, textual, etc.) for each condition of correct or missed identification, image removal, and threat items which do not contain threat images is _____. | NA | NA | textual |

# SPEARS CAPABILITIES SUMMARIES CHECKLIST

SPEARS REPORT SUMMARIES CHECKLIST

| | Evaluation | | |
|---|---|---|---|
| SPEARS Reports | Yes | No | Comments/Description |
| 1. Summary reports are automatically generated. | | | |
| 2. Summary reports are generated on demand. | | | |
| 3. Summary reports contain descriptive statistics. | | | |
| 4. Descriptive statistics are categorized according to:<br>a. threats presented and outcomes<br>b. screener identification<br>c. checkpoint activity level<br>d. time of day | | | |
| 5. Summary reports are readily understandable by the user (based on structured interview question results). | | | |
| 6. Performance levels for individual screeners per screening session are actively and accurately reported as a function of the probability of detection ($P_d$). | | | |
| 7. Performance level reports can be provided to a remotely situated supervisor. | | | |
| 8. A remotely situated supervisor can be notified when performance levels are above or below supervisor preset performance criteria thresholds. | | | |

# INTEROPERABILITY CHECKLIST

INTEROPERABILITY CHECKLIST

| | Evaluation | | |
|---|---|---|---|
| SPEARS Interoperability | Yes | No | Comments/Description |
| 1. A connection via modem can be established between two Screener Proficiency Evaluation and Reporting System (SPEARS) devices or a SPEARS device and a computer over standard telephone lines. | | X | |
| 2. The SPEARS remote connection requires no more than two people (one on-site, one at the remote site) to operate. | | X | |
| 3. New CTIs can be downloaded remotely to the SPEARS on-site device. | | X | |
| 4. New FTIs can be downloaded to the SPEARS on-site device. | | X | |
| 5. Status reports can be initiated remotely via the modem connection. | | X | |
| 6. Status report data can be accessed remotely and saved to a local computer file. | | X | |
| 7. Status reports can be printed out from the remote location. | | X | |
| 8. Remotely accessed status reports are similar to those available on-site from the SPEARS device. | | X | |
| 9. The time required to transfer a CTI remotely is _____. | NA | NA | |
| 10. The time required to transfer an FTI remotely is _____. | NA | NA | |

# SECURITY ACCESS CONTROL CHECKLIST - TnT

SECURITY ACCESS CONTROL CHECKLIST

| Security Access Control | Evaluation Yes | Evaluation No | Comments/Description |
|---|---|---|---|
| 1. The system provides controls to limit access rights. | X | | |
| 2. Access control can be limited to the granularity of a single user. | X | | |
| 3. The system provides controls to limit propagation of sensitive information. | X | | |
| 4. Files are protected from unauthorized access. | X | | |
| 5. Files are sensitivity labeled. | | X | The TnT does not use sensitivity labels. Files are not accessible to individuals who are not authorized. |
| 6. File sensitivity labels are used as a basis for access control decisions. | | X | No sensitivity labels. Individuals are prevented from accessing files if not authorized. |
| 7. Data are protected during transmission. | X | | |
| 8. When data are exported, a sensitivity label is included that accurately represents the level of security of the file. | | X | No sensitivity labels. Files are accessible to individuals who are not authorized. The only data that can be exported are system back-ups, which are put on a floppy disk. The information is encoded in an EG&G propriety format that only they can decode. Operating system is password protected. |
| 9. Procedures are established to control access to printed data. | X | | |
| 10. Users can access files only if their security level is greater than or equal to the security level of the file. | X | | |

| Security Access Control | Evaluation | | Comments/Description |
|---|---|---|---|
| | Yes | No | |
| 11. Users are required to enter identification before performing any actions. | X | | |
| 12. The system maintains data to authenticate user identity and level of access. | X | | |
| 13. Authentication data cannot be accessed by any unauthorized user. | X | | |
| 14. The system maintains an access audit trail. | X | | |
| 15. The access audit trail is protected from modification, unauthorized access, or destruction. | X | | |
| 16. The security mechanism of the system can be tested and works as claimed in the system documentation. | X | | |
| 17. Anyone external to those who have been granted access privileges cannot read, change, or delete data. | X | | |
| 18. Documentation is provided that describes the protection mechanisms provided by the system, and their use. | X | | |
| 19. A manual is provided to the system administrator that presents cautions about functions and privileges that should be controlled to maintain a secure system. | X | | |
| 20. The manual describes the operator and administrator functions related to security. | X | | |

| Security Access Control | Evaluation | | Comments/Description |
|---|---|---|---|
| | Yes | No | |
| 21. The manual provides guidelines on the consistent and effective use of the protection features of the system, how they interact, and how to successfully generate a new secure system. | X | | |

# SPEARS IMAGE INSERTION ISSUE CHECKLIST

SPEARS IMAGE INSERTION ISSUE CHECKLIST

| | Evaluation | | |
|---|---|---|---|
| SPEARS Insertion | Yes | No | Comments/Description |
| 1. FTIs can be generated using a computer generated threat object and neutral baggage image. | X | | |
| 2. FTIs can be automatically generated. | X | | FTIs cannot be generated by category |
| 3. FTIs are not predictable in the order they are presented. | X | | |
| 4. CTIs can be inserted into the normal baggage flow. | | X | |
| 5. CTIs can be automatically generated. | | X | |
| 6. CTIs are not predictable in the order they are presented. | | X | |
| 7. When an FTI and neutral bag image are combined, FTIs perceptually appear inside the neutral bag. | | | |
| 8. FTI position in the neutral bag can be randomly determined. | | | |
| 9. FTI orientation in the neutral bag can be controlled. | | | |

SUBJECT INFORMED CONSENT FORM

INFORMED CONSENT

I, ________________________________________, have received a briefing by the FAA representative as to the purpose of the FAA study. I fully understand the purpose of the study and have been provided with the opportunity to ask questions of the FAA representative. The FAA representative informed me that the study will require approximately 3 hours of training, followed by 3 baggage screening trials, and 30 minutes to complete a vision test and 1 hour to complete a hidden figures test.

I understand that this study will impose very little stress. The only stress I may experience in this experiment may be some initial frustration as I learn how to use the training system. As part of the data analysis, my data will be combined with that of other individuals and I will no longer be identifiable as a participant. I have been informed that my name will remain CONFIDENTIAL.

I have been informed that I have the right to withdraw from the experiment, and that the experiment monitor may terminate my participation in the interest of safety and the experiment. I also certify that I am at least 18 years of age.

I have been informed that if additional details are needed, I may contact any of the test administrators at the airport during the study, or contact James L. Fobes, Ph.D., (609) 485-4944; or Robert L. Malone, (609) 645-0900, upon completion of the study.

Signed: ________________________________________

Date: ______ / ______ /______

Witness: ________________________________________

Date: ______ / ______ /______

# SCREENER PERSONAL INFORMATION FORM
# (SPEARS OT&E SCREENER QUESTIONNAIRE)

FAA

SCREENER PROFICIENCY EVALUATION AND REPORTING SYSTEM

OPERATIONAL TEST AND EVALUATION

SCREENER QUESTIONNAIRE

DATE:________________________ SUBJECT NUMBER:________________________

1. What is your sex?

   Male _______ Female _______

2. How long have you been a baggage screener?

   ____________Years ____________Months

3. How long have you been using X-ray equipment to screen baggage?

   ____________Years ____________Months

4. What is the highest level of education or degree that you have completed.

   8th Grade or Less _______

   Some High School _______

   High School Graduate _______

   Some College or University _______

   College or University Graduate _______

5. Do you wear glasses while using the X-ray equipment?

Yes _______ No _______

FAA

SCREENER PROFICIENCY EVALUATION AND REPORTING SYSTEM

OPERATIONAL TEST AND EVALUATION

SCREENER QUESTIONNAIRE

(Continued)

6. Do you consider English to be your primary language?

Yes _______ No _______

If not, in which language are you most proficient? _______

If not, are you proficient with English? _______

# PROTOCOL IMPROVISED EXPLOSIVE DEVICE (IED) DETECTION TEST

PROTOCOL
IED DETECTION TEST

READ TO SCREENERS:

This is a test of how well X-ray machines work for detecting Improvised Explosive Devices (IEDs). For this activity, we have put X-ray images of passenger bags in this computer. You will view the X-ray images, one bag at a time, and inspect each bag for an IED. The images will be displayed on the video monitor.

INSTRUCTIONS TO SUBJECTS

After you have determined that your subject number on the monitor is correct, press the "ENTER" key on the keyboard to start the practice test. Initially, you will be given 10 images to practice on before beginning the real test. Once you see the first X-ray image appear on the monitor screen, your task will be twofold:

First, you will respond to the question: "Is there an IED in this X-ray image?" (The question will be shown at the bottom center of the monitor frame.)

To indicate "yes," press the key labeled "yes" on the keyboard.

To indicate "no," press the key labeled "no" on the keyboard.

Should you press the wrong key, an error message will appear on the monitor telling you that you pressed the wrong key.

Because we want to know how well the machines work, it is important that you answer each question to the best of your ability. It is just as important for you to say "no" when you do not see an IED as it is to say "yes" when you do see an IED.

You will have 10 seconds to make your response. However, you should answer as quickly as possible. Once you have made your response, you will not allowed to go back and change it.

If you have not answered the question after 6 seconds, an audible alarm will sound, alerting you that you have only 4 seconds left to answer the question.

If you still have not responded after 10 seconds, the image will disappear from the monitor screen and will be replaced by a prompt which advises you that, "Time has expired, please answer."

After you have responded to the first question, a second question will be displayed on the video monitor:

"How sure are you?"
yes = more sure        no = less sure

Respond by pressing the "yes" or "no" key on the keyboard or keypad, regardless of whether your answer to the first question was "yes" or "no". In either case, you will use the same two keys that you used to respond to the first question.

You will have 5 seconds to make this second response. If you have not yet answered this second question after 5 seconds, the question will disappear from the monitor screen and the prompt appear again telling you: "Time has expired, please answer." The system will not forward to the next image until you have made your response.

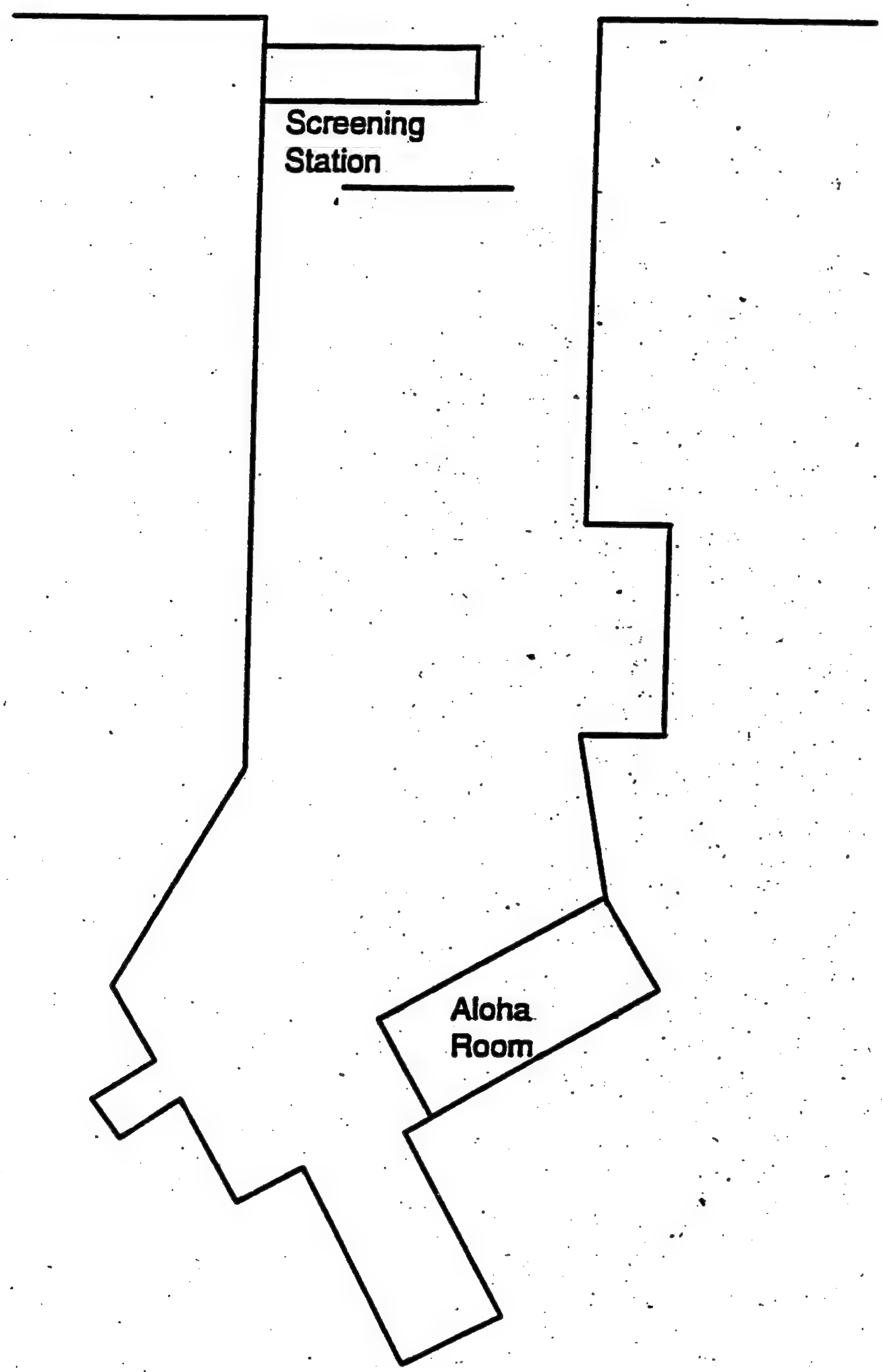
You will repeat this procedure for each image until all images have been viewed. A message will then appear on the monitor indicating that the test has ended. The test should take a little over an hour to complete.

Do you have any questions?

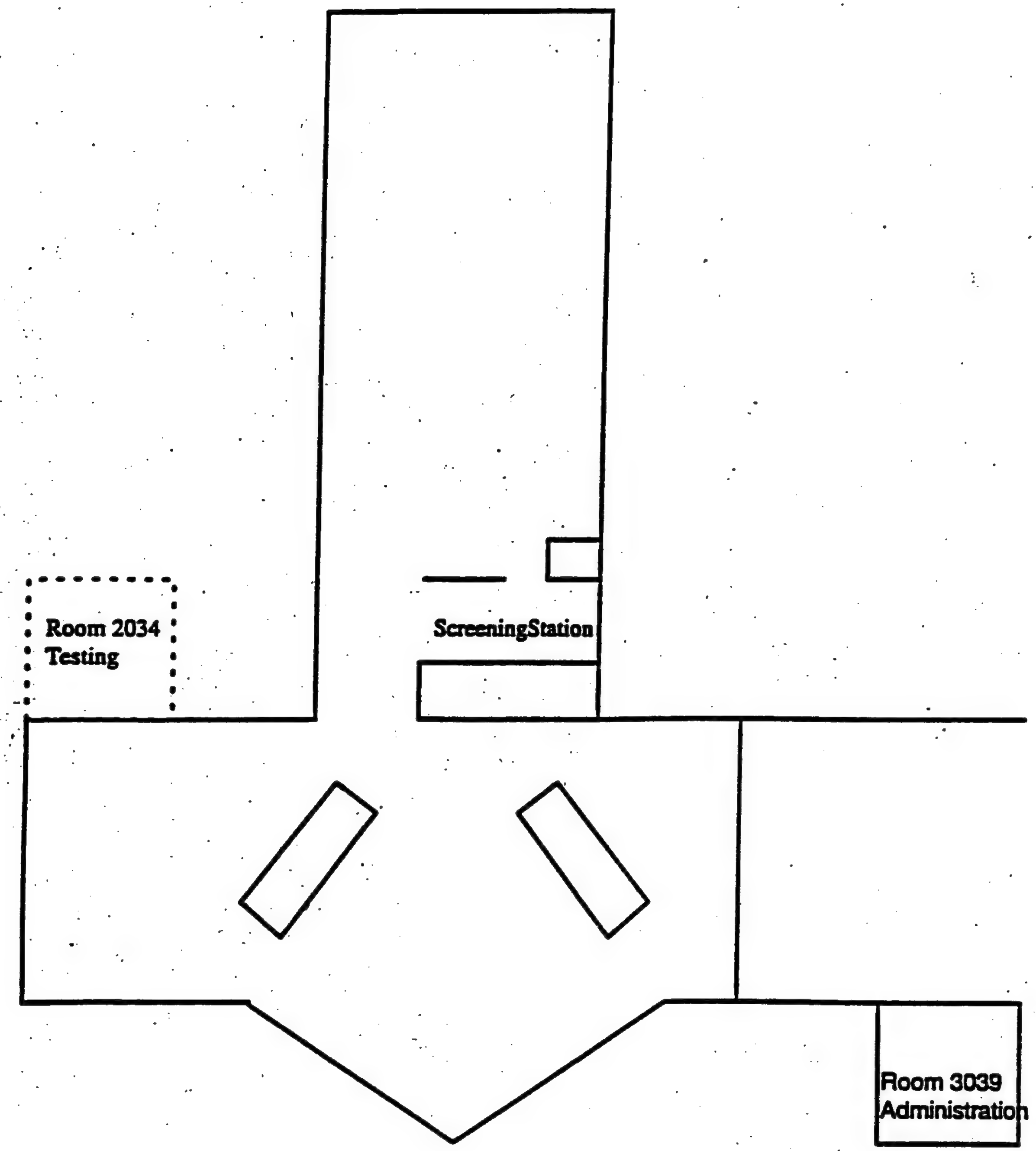
Thank you for participating in this test. Press the "ENTER" key on your keyboard to start the practice test. When you have completed the practice test, press the "ENTER" key again to start the real test.

# LOS ANGELES INTERNATIONAL AIRPORT
# SITE MAPS

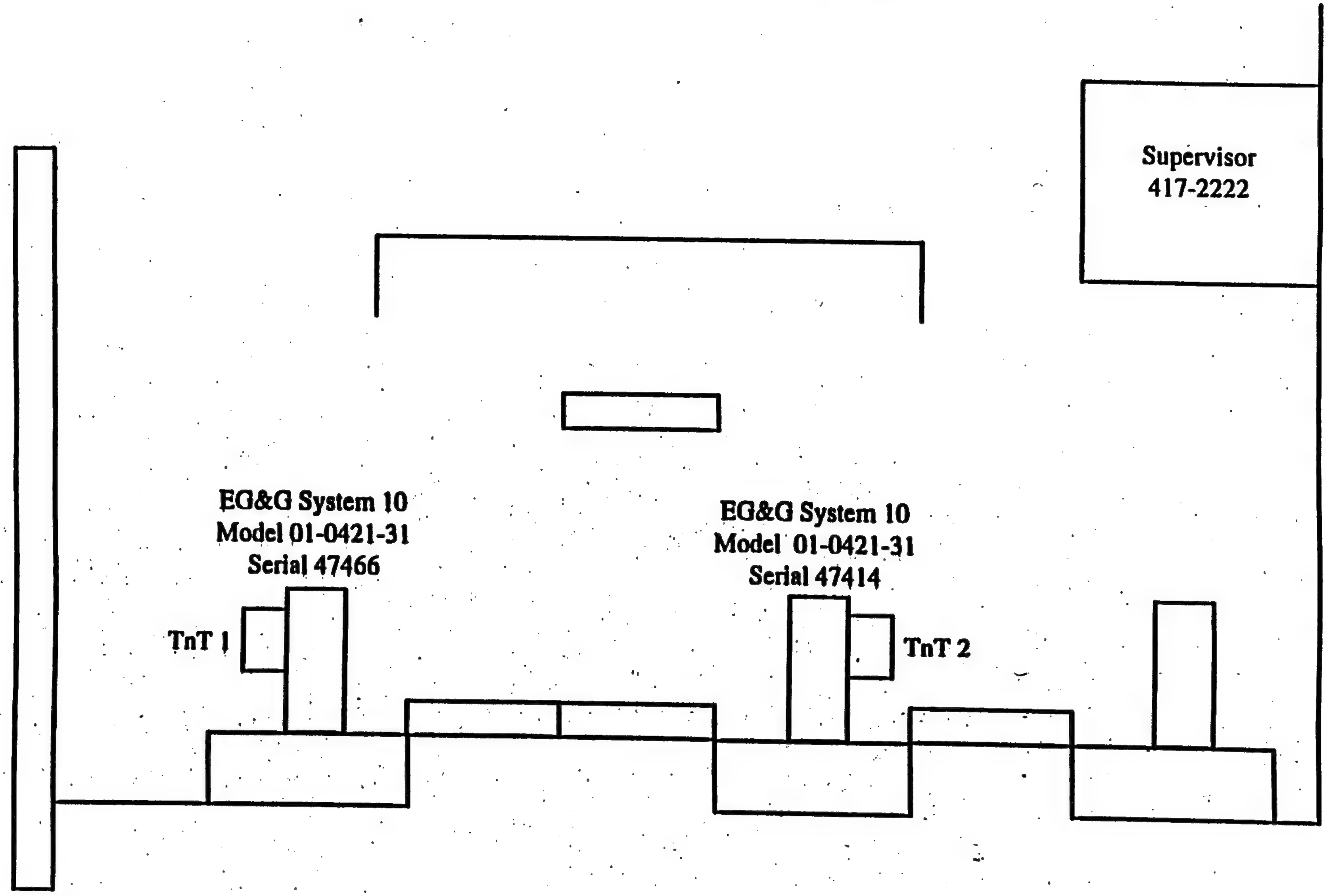
## LAX TERMINAL 7



# LAX TERMINAL 2

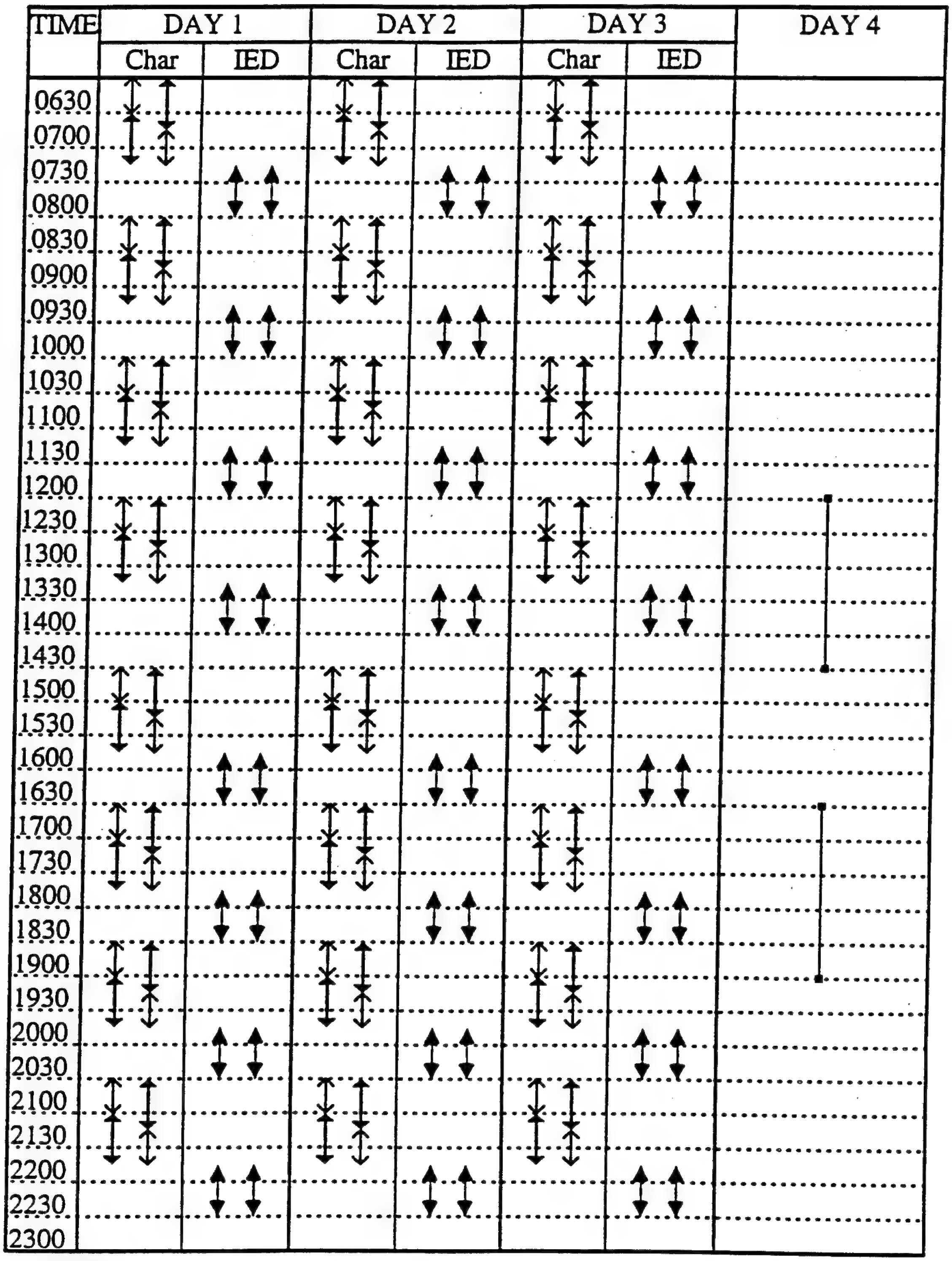


# LAX TERMINAL 2 SCREENING STATION



# SPEARS DETAILED TEST SCHEDULES
# (PRETEST, POSTTEST 1, AND POSTTEST 2)

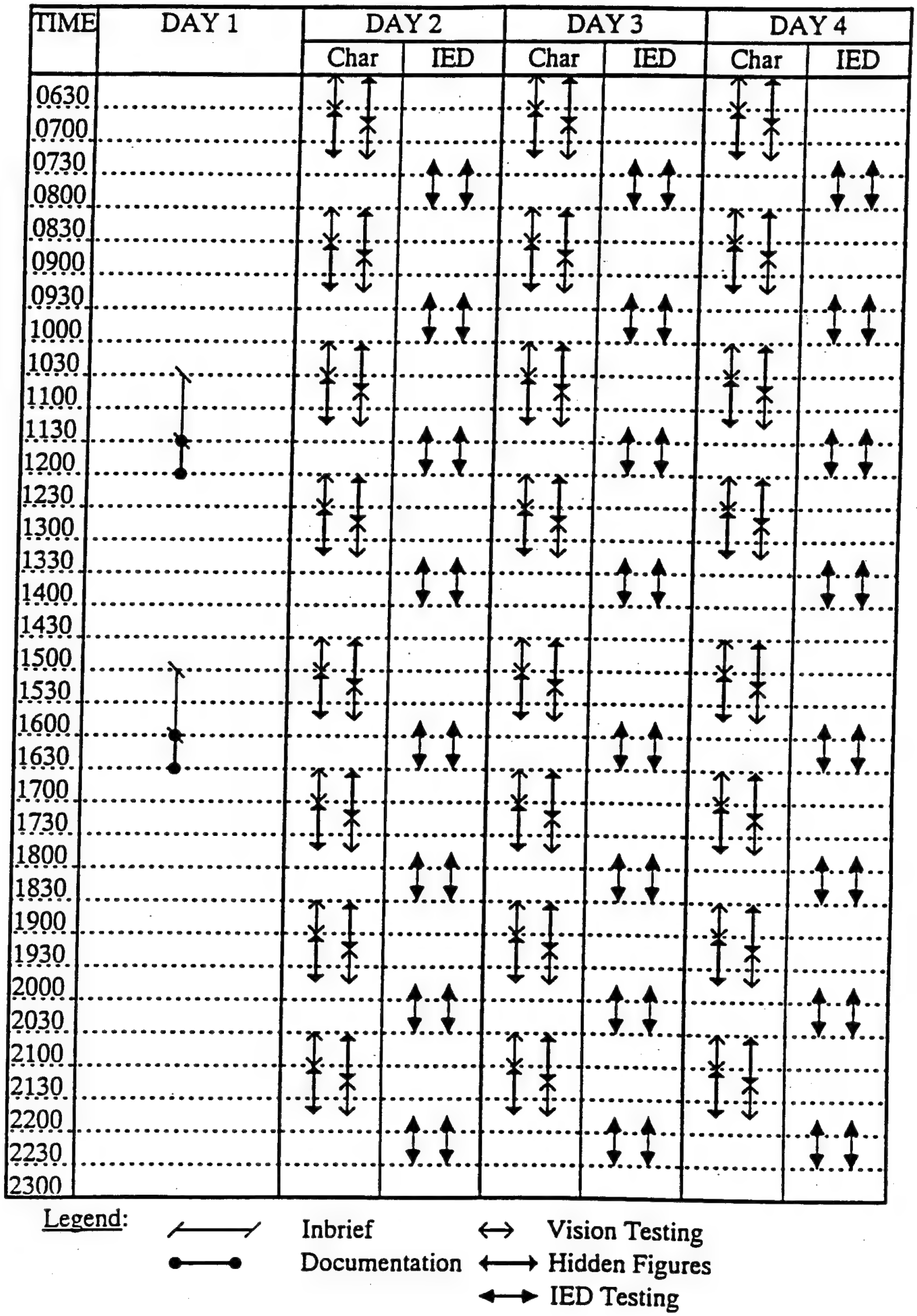
SPEARS ON-LINE OT&E PRE-TEST
TRAINING GROUP




Legend:

Vision Testing
Hidden Figures/Hidden Patterns
IED Testing
TIP Training

## SPEARS ON-LINE OT&E PRETEST
## CONTROL GROUP



# SPEARS ON-LINE OT&E POSTTEST 1
## TRAINING GROUP

| TIME | DAY 1 | |
|---|---|---|
| | | IED |
| 0630 | | |
| 0700 | | |
| 0730 | | |
| 0800 | | |
| 0830 | | |
| 0900 | | |
| 0930 | | |
| 1000 | | |
| 1030 | | |
| 1100 | | |
| 1130 | | |
| 1200 | | |
| 1230 | | |
| 1300 | | |
| 1330 | | |
| 1400 | | |
| 1430 | | |
| 1500 | | |
| 1530 | | |
| 1600 | | |
| 1630 | | |
| 1700 | | |
| 1730 | | |
| 1800 | | |
| 1830 | | |
| 1900 | | |
| 1930 | | |
| 2000 | | |
| 2030 | | |
| 2100 | | |
| 2130 | | |
| 2200 | | |
| 2230 | | |
| 2300 | | |

SPEARS ON-LINE OT&E POSTTEST 1
CONTROL GROUP

| TIME | DAY 1 | |
|---|---|---|
| | | IED |
| 0630 | | |
| 0700 | | |
| 0730 | | |
| 0800 | | |
| 0830 | | |
| 0900 | | |
| 0930 | | |
| 1000 | | |
| 1030 | | |
| 1100 | | |
| 1130 | | |
| 1200 | | |
| 1230 | | |
| 1300 | | |
| 1330 | | |
| 1400 | | |
| 1430 | | |
| 1500 | | |
| 1530 | | |
| 1600 | | |
| 1630 | | |
| 1700 | | |
| 1730 | | |
| 1800 | | |
| 1830 | | |
| 1900 | | |
| 1930 | | |
| 2000 | | |
| 2030 | | |
| 2100 | | |
| 2130 | | |
| 2200 | | |
| 2230 | | |
| 2300 | | |

Note: Training Group Day 1-2, Control Group Day 3-5

| TIME | DAY 1 | | DAY 2 | | DAY 3 | | DAY 4 | | DAY 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rating | IED | Rating | IED | Rating | IED | Rating | IED | Rating | IE |
| 0630 | | | | | | | | | | |
| 0700 | | | | | | | | | | |
| 0730 | | | | | | | | | | |
| 0800 | | | | | | | | | | |
| 0830 | | | | | | | | | | |
| 0900 | | | | | | | | | | |
| 0930 | | | | | | | | | | |
| 1000 | | | | | | | | | | |
| 1030 | | | | | | | | | | |
| 1100 | | | | | | | | | | |
| 1130 | | | | | | | | | | |
| 1200 | | | | | | | | | | |
| 1230 | | | | | | | | | | |
| 1300 | | | | | | | | | | |
| 1330 | | | | | | | | | | |
| 1400 | | | | | | | | | | |
| 1430 | | | | | | | | | | |
| 1500 | | | | | | | | | | |
| 1530 | | | | | | | | | | |
| 1600 | | | | | | | | | | |
| 1630 | | | | | | | | | | |
| 1700 | | | | | | | | | | |
| 1730 | | | | | | | | | | |
| 1800 | | | | | | | | | | |
| 1830 | | | | | | | | | | |
| 1900 | | | | | | | | | | |
| 1930 | | | | | | | | | | |
| 2000 | | | | | | | | | | |
| 2030 | | | | | | | | | | |
| 2100 | | | | | | | | | | |
| 2130 | | | | | | | | | | |
| 2200 | | | | | | | | | | |
| 2230 | | | | | | | | | | |
| 2300 | | | | | | | | | | |

REGAN VISUAL ACUITY CHART - HIGH CONTRAST 96 PERCENT

SCORE SHEE
SERIES 1

# Chart A - 96% Contrast

Patient Name ............................................................. Date ..........................

## Left Eye

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Z | R | D | O | V | C | N | S | 1 |
| H | R | V | C | O | S | K | Z | 2 |
| N | D | C | O | H | R | V | S | 3 |
| K | V | R | Z | C | O | H | S | 4 |
| Z | N | V | K | D | S | O | R | 5 |
| D | C | R | V | H | N | Z | K | 6 |
| O | S | K | C | V | R | Z | N | 7 |
| S | N | H | K | C | D | V | O | 8 |
| N | R | D | C | O | K | S | Z | 9 |
| V | H | C | O | R | Z | D | N | 10 |
| H | R | O | S | C | V | K | N | 11 |

| Number of Errors | Line Number | Score |
|---|---|---|
| | | |
| | | |
| | | |

## Right Eye

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Z | R | D | O | V | C | N | S | 1 |
| H | R | V | C | O | S | K | Z | 2 |
| N | D | C | O | H | R | V | S | 3 |
| K | V | R | Z | C | O | H | S | 4 |
| Z | N | V | K | D | S | O | R | 5 |
| D | C | R | V | H | N | Z | K | 6 |
| O | S | K | C | V | R | Z | N | 7 |
| S | N | H | K | C | D | V | O | 8 |
| N | R | D | C | O | K | S | Z | 9 |
| V | H | C | O | R | Z | D | N | 10 |
| H | R | O | S | C | V | K | N | 11 |

| Number of Errors | Line Number | Score |
|---|---|---|
| | | |
| | | |
| | | |

It is important to urge the patient to guess each letter, even when uncertain.
Mark each error by crossing out each letter missed.

# SCREENER INSTRUCTIONS

SCREENER OPERATING INSTRUCTIONS FOR TnT™ TIP

These instructions are intended to help you operate the Linescan System E-Scan X-ray machine when undergoing on-line training and testing during this study. As you know, the X-ray machine is used to screen hand-carried parcels to identify security threats. A new training device has been developed to help screeners such as yourself learn to use the E-Scan X-ray machine by taking self-paced training lessons and on-line training and testing offered by the Linescan Training and Testing system. (Throughout the rest of this guide, the term *Linescan TnT™* is used to refer to the training and testing system.)

## U.1 WHAT IS LINESCAN TnT™?

The Linescan TnT™ training system is a training tool developed to help you learn how to operate the E-Scan X-ray machine and how to identify security threats.

The training system itself is a combination of equipment and software (computer programs).

## U.2 PURPOSE OF THESE OPERATING INSTRUCTIONS.

The purpose of these operating instructions is to provide you with all the information you need to use Linescan TnT™ in the on-line training and testing mode. With it, you will learn how to:

a. log onto the system,
b. use Linescan TnT™ with the X-ray machine for on-the-job practice, and
c. log out of the system.

These instructions are *not* intended to teach you how to operate the E-Scan X-ray system or how to identify security threats.

## U.3 CONTENTS OF THESE INSTRUCTIONS.

These instructions cover the topics listed below:

a. Starting up the equipment.

b. Logging onto Linescan TnT™.

c. The Main Menu and the basics of using Linescan TnT™.

d. Instructions for using Linescan TnT™ when it is connected to the E-Scan X-ray machine for on-line training and testing when screening for parcels.

e. Logging out of Linescan TnT™.

U.4 WHAT IS ON-LINE TRAINING AND TESTING?

During *on-line training and testing,* you practice your skills in threat identification while operating the actual X-ray machine. You also learn what to do when you find a threat. On-line training and testing is conducted during an actual work shift.

For on-line training and testing, Linescan TnT™ is connected to the E-Scan X-ray machine. Your goal is to identify all threats that appear to pass through the X-ray machine. Linescan TnT™ then asks you to locate the specific threat you see in the X-ray image and to classify it as a gun, a knife, an explosive device, or a miscellaneous weapon. Then Linescan TnT™ displays a security procedure for you that tells you how to handle the kind of threat you have detected.

In on-line testing, your performance is recorded so that your manager can check your progress to see where your strengths and weaknesses are. This recording feature will be used by the FAA representatives to see how well the Linescan TnT™ trains screeners to find threats. **The recordings are confidential, and no one will know your results.**

U.5 GETTING STARTED.

This section tells you how to log onto the Linescan TnT™ training system as an authorized user. It also introduces the functions available to you as an operator and covers the basics of using the Linescan TnT™ screens. Finally, it tells you how to log out at the end of your work session.

U.5.1 Using the Trackball.

The most important part of learning to use Linescan TnT™ is learning to use the trackball. Take a few moments now to become familiar with using it.

*Pointing*

The trackball is a pointing device. As you roll the trackball, a pointer (usually but not always an arrow) moves on the screen in correspondence with the trackball's movement. You use the trackball to point at objects on the screen.

Sometimes the pointer is not an arrow. Sometimes it takes the shape of a pointing hand, usually when it is over a certain type of object on the screen. Other times, the pointer takes the shape of a wrist watch with hands that spin clockwise. This "wrist watch" indicates that the computer is processing your request and you should wait momentarily.

*Clicking*

In order to tell Linescan TnT™ what you want it to do, you have to do more than simply point at an object. To *select* the object (that is, to tell the computer you want to use that particular object), you *click* on it.

To click on an object that you have pointed at, press the pad on either side of the trackball. You will feel a slight "clicking" pressure, almost as if you have pressed a button, and you will hear a "click."

You use the actions of pointing and clicking throughout your interaction with Linescan TnT™. When this guide instructs you to select or to "click" or "click on" an object, you must first point at the object, then press the trackball pad.

### U.5.2 Simulated Control Panel.

You will often see on a Linescan TnT™ screen a control panel that looks like the control panel on the actual TnT™ machine. To use the simulated control panel on the screen (figure U-1), you will use the trackball to point at and click on its simulated buttons. In particular, you will click the square buttons in the center and the round buttons on either side. You will not click on the labels next to the round buttons.

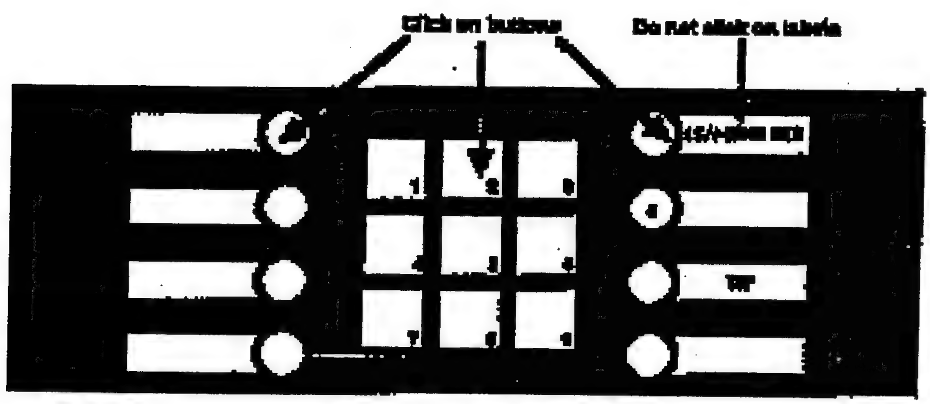


FIGURE U-1. SIMULATED CONTROL PANEL

### U.5.3 Logging onto Linescan TnT™.

Logging on is the process of identifying yourself to Linescan TnT™ as an authorized user. Only authorized users are allowed to have access to the Linescan TnT™.

*Before you log on*

You need an operator identification ("ID") number and a password in order to log in. You should have been given your operator ID and a password by your manager.

When you log on, Linescan TnT™ will already be turned on and the login screen and simulated control panel (figure U-2) will be displayed on the left monitor.

> NOTE: If the login screen and simulated control panel are not displayed on the left monitor, see your manager.

*Logging on*

a. On the logon screen and simulated control panel (figure U-2), enter your operator ID number. To do so, use the numbered buttons on the simulated control panel.

> NOTE: The digits 1 through 9 are on the square buttons in the center, while the digit 0 is on the second round button from the top to the right.

1. Click on each of the digits in the ID number. (As you click each digit, a beep is sounded.)

2. After clicking on all the digits in the ID, click the ENTER button.

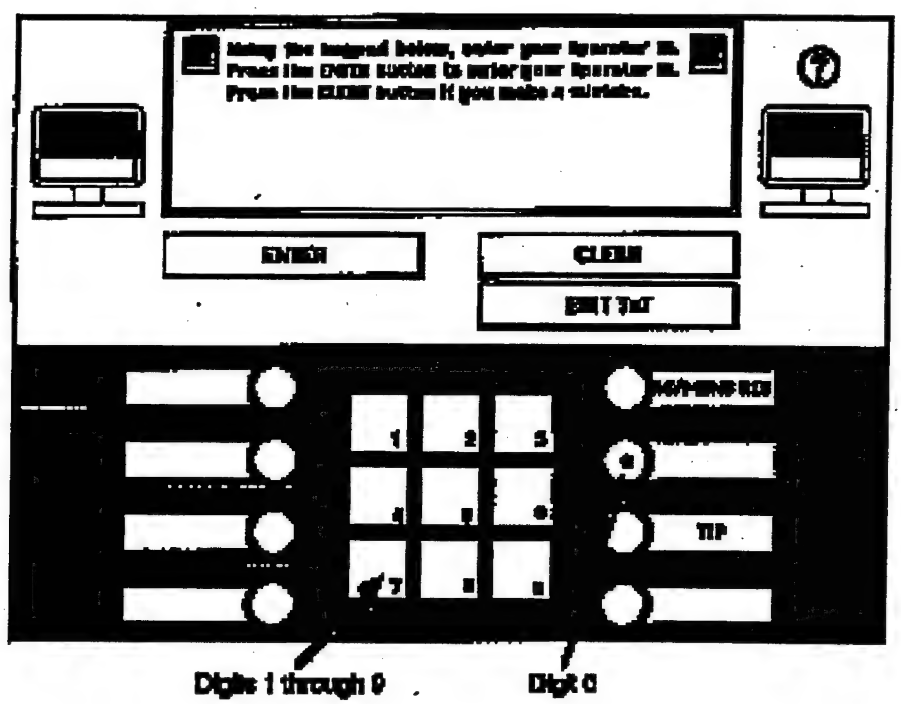



FIGURE U-2. LINESCAN TNT™ LOGIN SCREEN AND SIMULATED CONTROL PANEL

b. You can now use your password. To use your password, click on each of the digits in the password, then click ENTER.

U.5.3 Logging Out of Linescan TnT™.

Whenever you are finished using Linescan TnT™ or whenever you need to leave it unattended, even for a few minutes, you should log out (exit). By logging out, you ensure that no unauthorized person can access Linescan TnT™ information.

*Logging out*

a. Return to the Main Menu, if you are not already there.

If starting from some other Linescan TnT™ screen, click EXIT as needed until you return to the Main Menu.

b. At the Main Menu, click EXIT.

After a few moments, the Linescan TnT™ login screen and the simulated control panel appear on the left monitor. Linescan TnT™ is ready for another authorized user to log in.

NOTE: If you are also responsible for turning off the Linescan TnT™ training station, see your manager for instructions.

U.6 USING X-RAY MODE (ON-LINE TRAINING AND TESTING).

This section tells you how to use Linescan TnT™ in conjunction with the E-Scan X-ray machine for on-line training and testing.

U.6.1 Overview of X-Ray Mode.

To use Linescan TnT™ with the X-ray machine, you need to know about X-ray mode, Threat Image Projection (TIP), on-line testing, and on-line monitoring. To prepare yourself for using X-ray mode correctly, read the following overview information before trying to use the X-ray mode.

*What is x-ray mode?*

When you use Linescan TnT™ with the X-ray machine for on-line training and testing, you are using X-ray mode. During X-ray mode, you use the actual control panel on the X-ray machine to screen parcels. You can strip the inorganic parts of an X-ray image, change it to reverse monochrome, and enlarge the image to get a closer view.

*What is TIP?*

To give you on-line training and/or to test your threat identification skills, your manager can instruct Linescan TnT™ to project threat images into actual parcels that pass through the X-ray

machine. When Linescan TnT™ gets ready to project a threat image, it looks for a parcel that is large enough to hold the image it has to project. For example, if the image scheduled to be projected is a long item, and the next parcel that passes through the X-ray machine is a small, square package, Linescan TnT™ does not project the image into that parcel. It waits until it finds a parcel whose size is large enough to hold the projected image.

When Linescan TnT™ does find a suitable parcel, it projects the threat image into the X-ray image of the actual parcel. As far as you can tell, the projected image looks as real in the X-ray as the parcel itself.

A manager typically instructs Linescan TnT™ to project a certain number of images during a given period of time, such as a work shift. For example, he or she may schedule 20 images to be projected over 8 hours. Approximately every half hour an image will be projected. (However, remember that Linescan TnT™ may occasionally not project a threat image *if* it cannot find a parcel large enough to hold it.)

*What is on-line training and testing?*

*On-line training and testing* is the mode in which an X-ray will be used. In on-line training and testing, you will follow a procedure with several steps or stages.

When you think you have detected a threat (whether a projected threat or a real one), you will press the TIP button on the actual X-ray machine. (The TIP button on the simulated control panel of Linescan TnT™ is active as well.)

At this time, you are informed if you are being tested or not.

If the threat was a Projected Threat Image, it is now erased from the screen. All your responses are recorded by Linescan TnT™ so that the FAA representatives can see how well the TIP function works. You will learn more about this on-line testing later in this section.

*What are hits, misses, and suspected threats?*

***A hit** is* a projected threat image that you successfully detected.

***A miss** is* a projected threat image that you failed to detect. A miss occurs under two circumstances:

- The X-ray into which the image was projected may have stayed on the screen for too long without your detecting the projected threat. The amount of time in which you have to respond depends on how Linescan TnT™ has been set up.
- The X-ray image scrolled (moved) off the monitor screen before you pressed the TIP button.

***A suspected threat*** is a threat that you perceived to be in the parcel but that was not projected by Linescan TnT™. It might be a harmless item, or it might be a real threat. When this happens during on-line monitoring, Linescan TnT™ automatically saves the X-ray so that you and your manager can review it later.

U.6.2 Using X-Ray Mode.

*Starting up X-ray mode.*

Before you can use X-ray mode, Linescan TnT™ must be connected to the X-ray machine. Your manager or a service technician will have already connected them.

a. On the Main Menu, click X-ray mode.

NOTE: If you see the following message and Linescan TnT™ is not connected to the X-ray machine, see your manager. You will not be able to continue.

**PLEASE MAKE SURE THE X-RAY MACHINE IS ON AND ALL CABLES ARE PROPERLY CONNECTED**

b. Now operate the actual X-ray machine as you have been trained to screen parcels for threats.

**Important !!: The threats you see may be projected threat images or they may be actual threats.**

c. Continue to the procedure "Finding a threat during on-line training and testing."

*Finding a threat during on-line training and testing.*

Recall that during on-line training and testing, you will be tested with threat images projected by Linescan TnT™.

Important: Read this entire procedure before trying it to learn about the actions you will be required to take. If you were to find an actual threat in a parcel, you must be able to act quickly.

d. If you think you see a threat in a parcel passing through the X-ray machine, press the TIP button on the actual control panel.

If the threat you see...

- is a projected threat image, the following message appears on the monitor. After reading it, continue with Step 3.

**YOU HAVE CORRECTLY IDENTIFIED A PROJECTED THREAT!**
**CLICK ON THE THREAT OBJECT.**

- is not a projected threat image, the following message appears on the left monitor:

**YOU ARE NOT BEING TESTED AT THIS TIME.**
**FOLLOW THE SECURITY PROCEDURES FOR THE SUSPECTED THREAT!**
**PRESS DOWN ON THE TRACKBALL PAD TO CONTINUE.**

e. When you are ready to exit X-ray mode, refer to "Exiting X-ray mode" at the end of this section.

U.6.3 Exiting X-Ray Mode.

When you are ready to exit X-ray mode from either on-line training and testing or on-line monitoring, follow this procedure.

a. Press the TIP button on the TnT™.

If you are not being tested, an EXIT button appears in the lower left corner of the left monitor (as shown in the example in figure U-3).

NOTE: If you *are* being tested, the EXIT button does not appear. You must follow the standard procedure for identifying the projected threat. Afterward, you can exit X-ray mode.

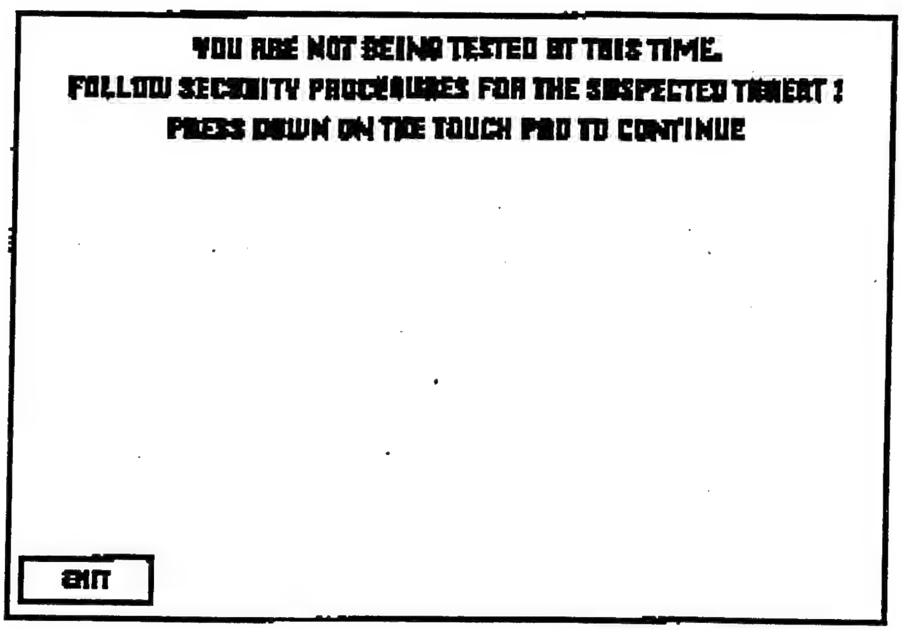


FIGURE U-3. EXIT BUTTON ON AN X-RAY MODE SCREEN

b. Click the EXIT button in the lower left corner. (If the button disappears before you have a chance to click it, just repeat from Step 1.)

c. X-ray mode is ended. After a few moments, you are returned to the Main Menu.

## SCREENER OPERATING CHECKLIST FOR TnT™ TIP

**CARRY OUT THESE STEPS EACH TIME YOU ARE ASSIGNED TO THE X-RAY MACHINE**

1. _____ Ensure the log on screen is showing on the left hand TnT™ monitor. If it is not on the left hand monitor, see your supervisor.

2. _____ Enter your ID number. If you do not know your ID number, or have forgotten it, see your supervisor. Click on each digit of your ID number on the simulated control panel on the screen using the trackball and the clicking pad. After you have entered in all digits, press ENTER.

3. _____ Using the trackball and the clicking pad, press X-ray Mode on the Main Menu

4. _____ Operate the actual X-ray machine as you have been trained to screen parcels for threats.

**CARRY OUT THESE STEPS EACH TIME YOU LEAVE THE X-RAY MACHINE**

1. _____ Press the TIP button. If you are not being tested, an EXIT button will appear in the lower left corner of the monitor. If you are being tested, the EXIT button will not appear. See your manager.

2. _____ Using the trackball and the clicking pad, press the EXIT button on the monitor until you reach the main menu.

3. _____ Using the trackball and clicking pad, press EXIT on the main menu.

# THREAT-IMAGE PROJECTION TRAINING AND TESTING AND OPERATIONAL TEST

THREAT-IMAGE PROJECTION TRAINING AND TESTING
AND OPERATIONAL TEST

Control Group

| Subject | Password | Date |
|---|---|---|
| 1 | 001 | |
| 2 | 002 | |
| 3 | 003 | |
| 4 | 004 | |
| 5 | 005 | |
| 6 | 006 | |
| 7 | 007 | |
| 8 | 008 | |
| 9 | 009 | |
| 10 | 010 | |
| 11 | 011 | |
| 12 | 012 | |
| 13 | 013 | |
| 14 | 014 | |
| 15 | 015 | |
| 16 | 016 | |
| 17 | 017 | |
| 18 | 018 | |
| 19 | 019 | |
| 20 | 020 | |
| 21 | 021 | |
| 22 | 022 | |
| 23 | 023 | |
| 24 | 024 | |
| 25 | 025 | |
| 26 | 026 | |
| 27 | 027 | |
| 28 | 028 | |
| 29 | 029 | |
| 30 | 030 | |

Training Group

| Subject | Password | Date |
|---|---|---|
| 31 | 031 | |
| 32 | 032 | |
| 33 | 033 | |
| 34 | 034 | |
| 35 | 035 | |
| 36 | 036 | |
| 37 | 037 | |
| 38 | 038 | |
| 39 | 039 | |
| 40 | 040 | |
| 41 | 041 | |
| 42 | 042 | |
| 43 | 043 | |
| 44 | 044 | |
| 45 | 045 | |
| 46 | 046 | |
| 47 | 047 | |
| 48 | 048 | |
| 49 | 049 | |
| 50 | 050 | |
| 51 | 051 | |
| 52 | 052 | |
| 53 | 053 | |
| 54 | 054 | |

# IMPROVISED EXPLOSIVE DEVICE DETECTION SYSTEM
# OT&E LINESCAN® TRAINING AND TESTING (TnT)
# OVERVIEW AND INSTRUCTIONS

## THE LINESCAN® TESTING AND TRAINING (TnT) OVERVIEW

The Linescan® TnT™ system is a computer-based training tool developed by EG&G Astrophysics to help baggage screeners operate Linescan® X-ray equipment with E-Scan and identify security threats. The training system provides four distinct types of training and testing: training lessons, real-time testing, real-time monitoring, and ongoing training and testing. The Operational Test and Evaluation (OT&E) presented baggage screeners with customized training lessons on detecting Improvised Explosive Devices (IEDs).

The TnT™ offers on-line and off-line operations. On-line operation provides real-time training and testing where operators can practice their skills in threat identification while operating an actual X-ray machine. Off-line training allows operators to learn and practice threat identification skills by taking training lessons without operating the X-ray machine.

Baggage screeners received off-line training to identify threats using black/white and enhanced X-ray equipment.

The TnT™ system is used to train baggage screeners to improve performance in detecting threatening objects. Screeners were required to identify threats using both black/white and enhanced X-ray equipment.

Linescan® TnT™ System Components and Operation.

The TnT™ system consists of a combination of equipment and software. The equipment consists of the following:

a. A color monitor and a black-and-white monitor (mounted side-by-side, just as the monitors are mounted on the actual E-Scan X-ray machine).

b. A control panel (mounted below the monitors) that replicates the control panel on the actual E-Scan X-ray machine.

c. A trackball (located to the right of the control panel) with which operators interact with the training programs.

d. A computer (located inside the equipment housing) that runs the training programs.

e. A variety of cables and connectors used to connect the training system to the X-ray and to recording equipment such as camcorders and video cassette recorders.

During the OT&E, participating baggage screeners received seven pre-determined lessons from the TnT™ Lessons menu. All lessons were previously completed at the Federal Aviation

Administration (FAA) Technical Center prior to conducting the OT&E. The FAA selected the training lessons for the OT&E. A copy of the TnT™ operating instructions was located on the TnT™, and an FAA representative monitored all screeners operating the TnT™.

All Linescan® TnT™ lessons were conducted in an office behind the United Airlines group check check-in counter.

The following instructions were provided to baggage screeners during the TnT™ training. An FAA representative was present during the training and provided baggage screeners with assistance when necessary.

LINESCAN® TRAINING AND TESTING (TnT) INSTRUCTIONS.

The Linescan® TnT training system is used to train baggage screeners to improve performance in detecting threat objects. By taking the following training lessons, one will learn to identify threats using both black/white and enhanced x-ray equipment. Review the seven training lessons identified in the Training Lessons Procedures list. Please do not take lessons that are not included on the list.

*If there are questions at any time, ask the Federal Aviation Administration (FAA) representative for assistance.*

Getting Started.

If there are questions about beginning the training lessons, turning the equipment on, or using available functions, ask the FAA representative for assistance.

Use the following procedures to begin the training:

Logon Procedures.

1. Using trackball, position the arrow on the visual display number pad.
2. Using the visual display number pad, enter the operator ID: **123**
3. Press the **ENTER** button to enter operator ID.
4. Using the visual display number pad, enter password: **123**
5. Press the **ENTER** button to enter password.
6. Press the **CLEAR** button if a mistake is made and to restart the logon procedures.
7. Press the **TIP** button on the TnT control panel.

Reviewing a Lesson.

After successfully logging onto the training system, complete the following steps:

1. Select the **Lessons** button from the opening screen.

   *The Lessons menu appears.*

2. On the Lessons menu, click **Review.**

   *The Review menu appears.*

3. To review a prior lesson, click **A Prior Lesson.**

   *A checklist of the lessons previously completed is displayed. It shows up to 10 lessons at a time. To bring other lessons into view, use the up and down arrows to the right of the lessons.*

4. To select the lesson to review, click on it.

   *Table W-1 shows a list of the lessons to review. Review the lessons in the order presented in table W-1.*

TABLE W-1. LIST OF LESSONS TO REVIEW

| | |
|---|---|
| Unit 2 | Lesson 1 |
| Unit 4 | Lesson 1 |
| Unit 4 | Lesson 3 |
| Unit 5 | Lesson 4 |
| Unit 6 | Lesson 1 |
| Unit 6 | Lesson 3 |
| Unit 7 | Lesson 1 |

   *When the lesson is presented, complete it by closely reading the information presented on the screens.*

5. Begin the appropriate lesson displayed on the right visual display (Lesson Screen).

6. When finished reviewing a lesson, immediately review the corresponding test.

# TEST BAG CONFIGURATIONS

Requests for descriptions of test bag configurations should be submitted in writing to the FAA program manager supporting this effort.

# CHECKED-CARRY-ON BAGGAGE - THREAT ARTICLE DEFINITION SHEETS

Requests for descriptions of threat article definitions should be submitted in writing to the FAA program manager supporting this effort.

# THREAT-IMAGE PROJECTION INSERTION PROTOCOL

TIP 1 INSERTION PROTOCOL

| TOTAL | 8 | 12 | 10 | 3 | 12 | 9 | 9 | 7 | 4 | 2 | 2 | 6 | 5 | 6 | 5 | 5 | 11 | 12 | 12 | 6 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DAY | | | | | | | | | | | | | | | | | | | | |
| TIME | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** |
| 630 | 2 | 3 | 2 | 0 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 1 | 2 |
| 730 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 2 |
| 830 | 2 | 3 | 3 | 1 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 2 | 1 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 2 |
| 930 | 2 | 3 | 2 | 0 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 3 |
| 1030 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 1 | 2 |
| 1130 | 2 | 3 | 3 | 1 | 3 | 2 | 2 | 2 | 0 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 2 |
| 1230 | 2 | 3 | 3 | 1 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 1 | 2 |
| 1330 | 2 | 3 | 2 | 0 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 3 | 3 | 2 | 3 |
| 1430 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 1 | 2 |
| 1530 | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 1 | 0 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 1630 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 1 | 2 |
| 1730 | 2 | 3 | 2 | 0 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 3 | 3 | 1 | 3 |
| 1830 | 2 | 3 | 2 | 1 | 3 | 2 | 2 | 2 | 1 | 0 | 0 | 2 | 1 | 2 | 1 | 1 | 3 | 3 | 3 | 2 | 2 |
| 1930 | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 2 |
| 2030 | 2 | 3 | 3 | 1 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 3 | 1 | 2 |
| 2130 | 2 | 3 | 2 | 0 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 3 | 2 | 3 | 2 | 2 |
| 2230 | 0 | 3 | 2 | 1 | 3 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 2 | 3 | 3 | 0 | 1 |

TIP 2 INSERTION PROTOCOL
WEEKS 1-3

| TOTAL | 12 | 1 | 5 | 12 | 1 | 4 | 4 | 8 | 10 | 11 | 11 | 11 | 11 | 8 | 10 | 10 | 12 | 12 | 12 | 3 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DAY | | | | | | | | | | | | | | | | | | | | |
| TIME | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** |
| 630 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 0 | 2 | 3 | 3 | 3 | 3 | 0 | 2 | 2 | 3 | 3 | 3 | 0 | 2 |
| 730 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 2 |
| 830 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 0 | 3 | 3 | 3 | 3 | 3 | 0 | 3 | 3 | 3 | 3 | 3 | 1 | 3 |
| 930 | 3 | 0 | 2 | 3 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 0 | 2 |
| 1030 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 0 | 2 | 3 | 3 | 3 | 3 | 0 | 2 | 2 | 3 | 3 | 3 | 1 | 2 |
| 1130 | 2 | 1 | 1 | 2 | 1 | 0 | 0 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 1 | 3 |
| 1230 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 0 | 3 | 3 | 3 | 3 | 3 | 0 | 3 | 3 | 3 | 3 | 3 | 1 | 3 |
| 1330 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 0 | 2 |
| 1430 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 0 | 2 | 3 | 3 | 3 | 3 | 0 | 2 | 2 | 3 | 3 | 3 | 1 | 2 |
| 1530 | 3 | 1 | 2 | 3 | 1 | 1 | 1 | 0 | 3 | 2 | 2 | 2 | 2 | 0 | 3 | 3 | 3 | 3 | 3 | 1 | 3 |
| 1630 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 0 | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 2 | 3 | 3 | 3 | 1 | 2 |
| 1730 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 0 | 2 |
| 1830 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 0 | 2 | 3 | 3 | 3 | 3 | 0 | 2 | 2 | 3 | 3 | 3 | 1 | 3 |
| 1930 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 1 | 3 |
| 2030 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 0 | 2 | 3 | 3 | 3 | 3 | 0 | 2 | 2 | 3 | 3 | 3 | 1 | 2 |
| 2130 | 3 | 0 | 2 | 3 | 0 | 1 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 | 0 | 2 |
| 2230 | 3 | 0 | 1 | 3 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 3 | 2 | 3 | 3 | 3 | 1 | 2 |

TIP 2 INSERTION PROTOCOL
WEEKS 4-6

| TOTAL | 10 | 9 | 8 | 6 | 3 | 12 | 6 | 10 | 3 | 5 | 9 | 4 | 12 | 2 | 2 | 3 | 11 | 4 | 3 | 7 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DAY | | | | | | | | | | | | | | | | | | | | |
| TIME | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 |
| 630 | 2 | 2 | 0 | 1 | 0 | 3 | 1 | 2 | 0 | 1 | 2 | 1 | 3 | 0 | 0 | 0 | 3 | 1 | 0 | 2 | 1 |
| 730 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| 830 | 3 | 2 | 0 | 2 | 1 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 3 | 0 | 0 | 1 | 3 | 1 | 1 | 2 | 2 |
| 930 | 2 | 3 | 1 | 2 | 0 | 3 | 2 | 2 | 0 | 2 | 3 | 1 | 3 | 1 | 1 | 0 | 2 | 1 | 0 | 2 | 2 |
| 1030 | 2 | 2 | 0 | 1 | 1 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 0 | 0 | 1 | 3 | 1 | 1 | 2 | 1 |
| 1130 | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 0 | 2 | 1 | 1 | 1 | 2 | 0 | 1 | 2 | 2 |
| 1230 | 2 | 2 | 0 | 1 | 1 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 0 | 0 | 1 | 3 | 1 | 1 | 1 | 1 |
| 1330 | 3 | 3 | 1 | 2 | 0 | 3 | 2 | 2 | 0 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 0 | 2 | 2 |
| 1430 | 2 | 2 | 0 | 1 | 1 | 3 | 1 | 3 | 1 | 1 | 2 | 1 | 3 | 0 | 0 | 1 | 3 | 1 | 1 | 2 | 1 |
| 1530 | 3 | 2 | 0 | 2 | 1 | 3 | 2 | 3 | 1 | 2 | 2 | 1 | 2 | 0 | 0 | 1 | 2 | 1 | 1 | 2 | 2 |
| 1630 | 2 | 2 | 0 | 1 | 1 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 0 | 0 | 1 | 2 | 1 | 1 | 2 | 1 |
| 1730 | 2 | 3 | 1 | 1 | 0 | 3 | 1 | 2 | 0 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 0 | 1 | 1 |
| 1830 | 2 | 2 | 0 | 2 | 1 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 3 | 0 | 0 | 1 | 3 | 1 | 1 | 2 | 2 |
| 1930 | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
| 2030 | 2 | 2 | 0 | 1 | 1 | 3 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 0 | 0 | 1 | 3 | 1 | 1 | 1 | 1 |
| 2130 | 2 | 2 | 1 | 2 | 0 | 3 | 2 | 3 | 0 | 2 | 2 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 0 | 2 | 2 |
| 2230 | 3 | 1 | 1 | 0 | 1 | 3 | 0 | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 0 |

# TIP 2 INSERTION PROTOCOL
## WEEKS 7-8

| TOTAL | 10 | 6 | 12 | 9 | 9 | 3 | 6 | 8 | 12 | 10 | 10 | 10 | 5 | 10 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DAY | | | | | | | | | | | | | | | | | | | | |
| TIME | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | | | | | | | |
| 630 | 2 | 1 | 3 | 2 | 2 | 0 | 1 | 0 | 3 | 2 | 2 | 2 | 1 | 2 | | | | | | | |
| 730 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | | | | | | | |
| 830 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 0 | 3 | 3 | 3 | 3 | 1 | 3 | | | | | | | |
| 930 | 3 | 2 | 3 | 3 | 3 | 0 | 2 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | | | |
| 1030 | 2 | 1 | 3 | 2 | 2 | 1 | 1 | 0 | 3 | 2 | 2 | 2 | 1 | 2 | | | | | | | |
| 1130 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 3 | 3 | 3 | 3 | 1 | 3 | | | | | | | |
| 1230 | 2 | 1 | 3 | 2 | 2 | 1 | 1 | 0 | 3 | 3 | 2 | 2 | 1 | 2 | | | | | | | |
| 1330 | 2 | 2 | 3 | 3 | 3 | 0 | 2 | 1 | 3 | 2 | 2 | 3 | 1 | 3 | | | | | | | |
| 1430 | 2 | 1 | 3 | 2 | 2 | 1 | 1 | 0 | 3 | 3 | 3 | 2 | 1 | 2 | | | | | | | |
| 1530 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 0 | 2 | 3 | 3 | 3 | 2 | 3 | | | | | | | |
| 1630 | 2 | 1 | 3 | 2 | 2 | 1 | 1 | 0 | 3 | 2 | 2 | 2 | 1 | 2 | | | | | | | |
| 1730 | 2 | 1 | 3 | 3 | 3 | 0 | 1 | 1 | 3 | 2 | 2 | 2 | 1 | 2 | | | | | | | |
| 1830 | 2 | 2 | 3 | 2 | 2 | 1 | 2 | 0 | 3 | 2 | 2 | 2 | 1 | 2 | | | | | | | |
| 1930 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | 3 | 1 | 3 | | | | | | | |
| 2030 | 2 | 1 | 3 | 2 | 2 | 1 | 1 | 0 | 3 | 2 | 2 | 2 | 2 | 3 | | | | | | | |
| 2130 | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 1 | 3 | 2 | 3 | 3 | 1 | 2 | | | | | | | |
| 2230 | 3 | 0 | 3 | 1 | 1 | 1 | 0 | 1 | 3 | 2 | 2 | 2 | 1 | 2 | | | | | | | |

# NORTHWEST AIRLINES DAILY DEPARTURES - LOS ANGELES INTERNATIONAL AIRPORT

**NORTHWEST AIRLINES DAILY DEPARTURES**
**LOS ANGELES INTERNATIONAL AIRPORT**

| TIME | DEPARTURES | | | | | #/Total |
|---|---|---|---|---|---|---|
| 6:30 | MSP | RSW | | | | |
| 6:50 | FAT | | | | | 0.07 |
| 7:10 | MEM | SAN | | | | |
| 7:30 | SEA | | | | | |
| 7:50 | MSP | FAT | | | | 0.07 |
| 8:10 | BOS | PSP | | | | |
| 8:30 | DTW | SAN | YYZ | | | |
| 8:50 | HNL | NGO | SBP | | | 0.11 |
| 9:10 | MRY | PSP | | | | |
| 9:30 | SBA | | | | | |
| 9:50 | SAN | SEA | | | | 0.04 |
| 10:10 | | | | | | |
| 10:30 | PHX | | | | | |
| 10:50 | LAS | | | | | 0.03 |
| 11:10 | | | | | | |
| 11:30 | BOS | FAT | SAN | SAN | | |
| 11:50 | LAS | MSP | SFO | | | 0.15 |
| 12:10 | DTW | HNL | KIX | MNL | | |
| 12:30 | LGW | FAT | PHX | SAN | SEA | |
| 12:50 | MRY | ONT | PSP | SBA | SBP | 0.20 |
| 13:10 | MEM | MKE | NRT | PEK | SHA | |
| 13:30 | | | | | | |
| 13:50 | SEL | | | | | 0.01 |
| 14:10 | | | | | | |
| 14:30 | BOS | MSP | | | | |
| 14:50 | SAN | | | | | 0.04 |
| 15:10 | | | | | | |
| 15:30 | FAT | PSP | SAN | | | |
| 15:50 | MSP | | | | | 0.09 |
| 16:10 | AMS | DTW | MRY | | | |
| 16:30 | | | | | | |
| 16:50 | | | | | | |
| 17:10 | | | | | | |
| 17:30 | | | | | | |
| 17:50 | SAN | | | | | 0.01 |
| 18:10 | | | | | | |
| 18:30 | FAT | ONT | | | | |
| 18:50 | | | | | | 0.03 |
| 19:10 | | | | | | |
| 19:30 | LAS | | | | | |
| 19:50 | PSP | | | | | 0.04 |
| 20:10 | SAN | | | | | |
| 20:30 | | | | | | |
| 20:50 | FAT | | | | | 0.04 |
| 21:10 | MRY | SBA | | | | |
| 21:30 | | | | | | |
| 21:50 | | | | | | |
| 22:10 | | | | | | |
| 22:30 | | | | | | |
| 22:50 | DTW | FAT | LAS | | | 0.08 |
| 23:10 | ONT | PSP | SBP | | | |

<u>Legend</u>:

| | |
|---|---|
| AMS | Amsterdam |
| BOS | Boston |
| DTW | Detroit |
| FAT | Fresno |
| HNL | Honolulu |
| KIX | Osaka |
| LAS | Las Vegas |
| LGA | LaGuardia |
| LGW | Gatwick |
| MEM | Memphis |
| MIA | Miami |
| MKE | Milwaukee |
| MNL | Manila |
| MRY | Monterey |
| MSP | Minneapolis |
| NGO | Nagaro |
| NRT | Narita |
| ONT | Ontario |
| PEK | Beejing |
| PHX | Pheonix |
| PSP | Palm Springs |
| RSW | Fort Meyers |
| SAN | San Diego |
| SBA | Santa Barbara |
| SBP | San Luis Obispo |
| SEA | Seattle |
| SEL | Seoul |
| SFO | San Francisco |
| SHA | Shangai |
| YYZ | Toronto |

Note: Northwest Airlines accounts for approximately 75% of enplanements using this checkpoint. Other airlines using this terminal checkpoint include Virgin Air, Asiana, Air Canada, Hawaiian Air, Vast, and Air New Zealand.